THE AMERICAN JOURNAL OF ROENTGENOLOGY, RADIUM THERAPY AND NUCLEAR MEDICINE

VOL. 71 MARCH, 1954 No. 3

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THE AMERICAN JOURNAL OF ROENTGENOLOGY
RADIUM THERAPY AND NUCLEAR MEDICINE

VOL. 71 MARCH, 1954 No. 3

THE DEVELOPMENT OF THE COLON EXAMINATION*

By CLYDE A. STEVENSON, M.D.
From the Scott and White Clinic
TEMPLE, TEXAS

I AM grateful to the sponsors of the Hickey Memorial Lecture for the privilege of participating in this annual commemoration of such an outstanding man. Preston M. Hickey has been eulogized by your previous guest lecturers and some had the good fortune to know him personally. To those of us in the next generation of radiologists, the accomplishments of Dr. Hickey are astounding. His extensive bibliography covered a wide range of subjects about and related to radiology and the contents of his papers are just as pertinent today as they were twenty, thirty or more years ago. This written record of Dr. Hickey's achievements has been and is of marked importance to the medical profession but of equal value was his ability to teach and inspire young physicians so that they could further advance the art and science of radiology.

To those who knew Dr. Hickey there was no need to search for reasons for his success because he was a good man of great character who had an outstanding ability to make friends. To those who did not know Dr. Hickey, a review of writings by and concerning him shows that he was an outstanding physician practicing in Detroit before Röntgen announced his epochal discovery. Dr. Hickey was chiefly interested in disease of the nose, throat and lungs. His hobby was photography so it is easy to see how he was prepared to use the roentgen rays shortly after their discovery. I am sure that other men with the same interests and hobby were present at this time but few if any achieved Hickey's greatness. I think the clue to this differentiation was his profound interest in pathology. He lectured on pathology here in Detroit and during his twenty-two year tenure as Professor of Radiology at the Detroit College of Medicine and Surgery he fully utilized his knowledge of pathology to improve the diagnostic yield of the roentgen examination. During his eight year period, 1922–1930, at the University of Michigan he emphasized the pathologic basis of roentgen interpretation. In 1931 Dr. A. S. Warthin,[29] professor of pathology at Ann Arbor said, in memoriam, "My chief association with Dr. Hickey during the eight years of his professorship was in the Friday afternoon clinical-pathological conferences. In these he showed an intense interest, and attended

* The Hickey Memorial Lecture presented before the Detroit Roentgen Ray and Radium Society, Detroit, Michigan, March 5, 1953.

them as long as his strength permitted. His training in pathology gave him a special appreciation of the revelations of the autopsy and microscopic study of the cases presented in these conferences. He was always eager to correlate the pathologic findings with the roentgen diagnosis, and took great pains to explain discrepancies of interpretation!"

Among the many branches of diagnostic roentgenology which attracted Hickey's attention was that of the gastrointestinal tract. In 1927 at a meeting of the Minnesota State Medical Society, Dr. Hickey[17] presented a paper entitled "The Evaluation of a Gastro-intestinal Report."

I would like to quote directly from this paper of Dr. Hickey's for his statements made a quarter of a century ago can be aptly applied to our present-day examination of the colon. He stated, "In looking back [previous to 1927] over the history of the development of x-ray examinations of the gastro-intestinal tract, one is impressed by the fact that during the earlier evolutionary period the final diagnosis lay in massing together of so-called indirect signs. At the present time, however, the roentgen diagnosis is based primarily on the direct demonstration of the lesion.

"The roentgenologist is a practising physician and should be, and usually is, well educated in clinical history, modern pathology, and co-related methods of diagnosis. If he acquaints himself with the clinical symptoms he will be able to stress certain parts of his examination productive of value to the clinician and the patient.

"In cases where the x-ray examination is the principal factor in deciding for or against operative procedure, it is highly advisable to have a second confirmatory examination before pronouncing the final diagnosis."

THE EVOLUTION OF THE CONDUCT OF THE COLON EXAMINATION

In the development of the colon examination it must be remembered that physicians examined the colon long before Röntgen's discovery. Ordinary physical examination yielded some results but simple air insufflation aided palpation and percussion so that the examiner could determine the position of the colon with reference to an abdominal tumor.

Within a year after Röntgen's discovery, Becher[1] in Germany and Cannon[6] in this country roentgenographically demonstrated various portions of the gastrointestinal tract with salts of heavy metal. In 1901 Hildebrand[18] and Rumpel[19] obtained roentgenograms of the colon after giving a patient bismuth orally for several days and and then injecting air via the rectum. Because of the common pre-Röntgen usage of air insufflation of the colon, it is only natural that some of the early experimenters used the combined method of injecting air and opaque salts. In 1911 Haenisch[16] reported on the superiority of the contrast enema over the contrast meal for examination of the colon and apparently his observations were well received. Most of the early roentgenographic studies of the colon were done by means of ingested bismuth but because of the occasional erroneous admixture of toxic soluble salts to bismuth subnitrate, barium sulfate gradually replaced bismuth as the roentgen opaque substance for all gastrointestinal tract visualization.

From 1911 to 1923 the opaque enema was the method of choice for the colon examination and it fell to these early investigators to correlate the roentgenologic and pathologic findings so that criteria could be established for the recognition of various colon diseases.

The chief progress in roentgenologic diagnosis of colon disease was made by Stierlin,[26] Schilling and Schwarz,[20] Groedel,[15] Haenisch and Krause in Germany, while in this country Cole,[9] Brown and Sampson,[4] Case,[8] and Carman[7] contributed significant advances to the diagnosis of colon diseases.

In 1923 and again in 1925 Fischer[10,11] of Germany described in great detail his method for accomplishing the double contrast examination of the colon. He de-

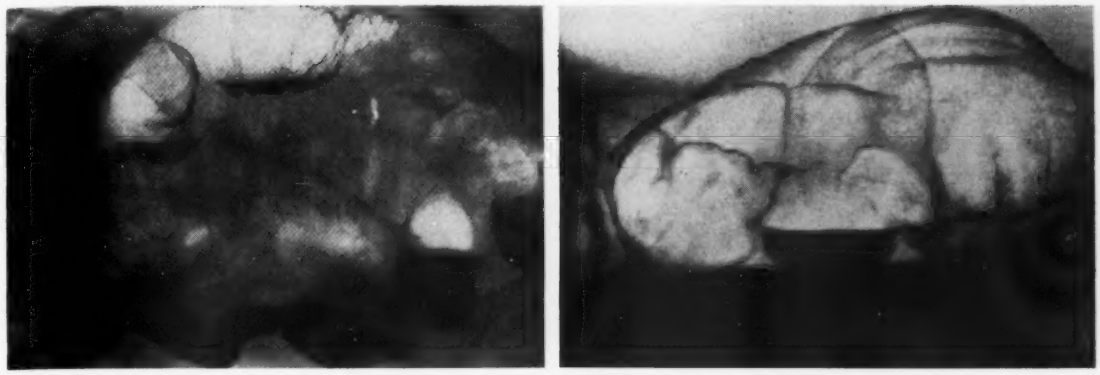

Fig. 1. This is an example from Fischer's original work. He used many different positions (lateral decubitus illustrated here) and obtained a good double contrast effect.

scribed his experiments with surgically resected lengths of colon and found that by using a suspension of barium sulfate, hydrated aluminum silicate and water he could obtain excellent double contrast roentgenograms, provided that only a small amount of the suspension was used and the specimen vigorously shaken so that the walls of the colon would be thoroughly covered and then, following this, distention of the specimen by air injection.

Fischer then applied this method to the patient. He used the special barium mixture and roentgenoscoped the patient. Depending upon each individual case he would introduce air without permitting any evacuation of the barium or would allow partial or complete evacuation followed immediately by insufflation under roentgenoscopic control (Fig. 1).

The main advantages claimed by Fischer for his procedure were the ability of air to penetrate stenosing lesions better than the heavy barium suspension, the ability of the examiner to "see through" overlapping loops of colon plus the fact that intraluminal polypoid tumors could be visualized which might be completely obscured by a solid column of barium.

Fischer laid the groundwork for the detection of relatively small intraluminal polypoid tumors and showed by means of a diagram (Fig. 2), that polypoid tumors were easily obscured by a solid mass of barium. He concluded that his double contrast method was superior to the single contrast but his original article does not show any roentgenograms of small polyps.

In 1928 while on a medical study trip in Europe, B. R. Kirklin of the Mayo Clinic

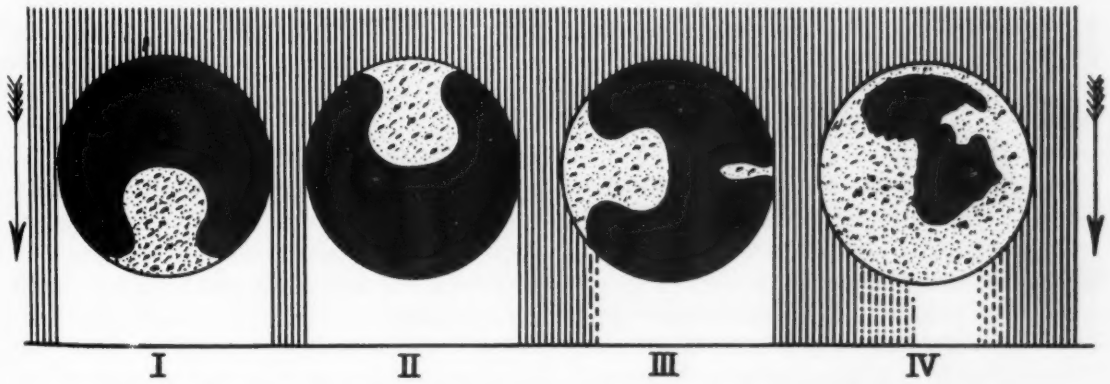

Fig. 2. By means of this diagram Fischer showed how a solid column of barium could obscure an intraluminal polypoid tumor.

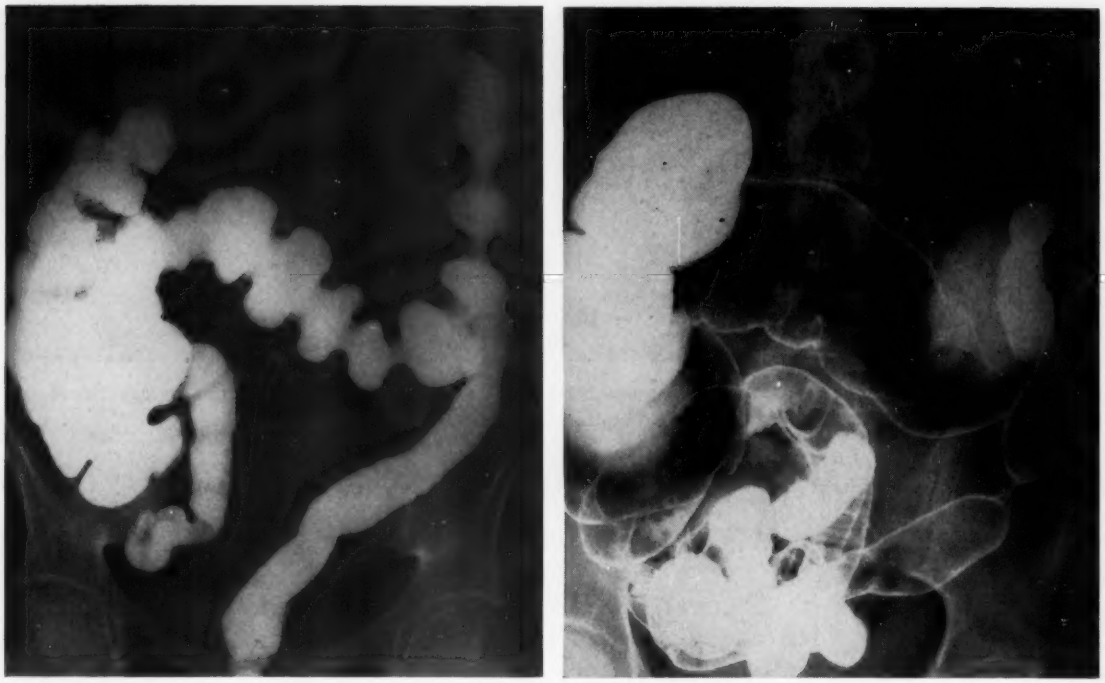

Fig. 3. Type 1 chronic ulcerative colitis. Roentgenoscopy and roentgenograms showed involvement to the hepatic flexure. Note how the double contrast examination erases the changes in the transverse colon.

visited with Fischer and was greatly impressed with the potentialities of the examination. On returning home Kirklin relayed his impressions of the Fischer method to one of his associates, Harry M. Weber. After about two years of constant effort Weber[30] modified and improved the double contrast technique so that he could produce consistently diagnostic roentgenograms. Thus in 1930 the American version of the double contrast examination was established. Weber soon realized the value as well as the limitations of the double contrast examination and, as the result of study of many thousands of colon examinations, he did not neglect the single contrast study.

From 1930 up to the present time Weber has contributed to the medical literature almost forty papers on disease of the colon, and while many others have been seriously interested in the colon examination and have contributed worth while studies, Weber's work is classical and roentgenologists have attempted to emulate his success.

For some obscure reason, few radiologists were able to reproduce the double contrast examination as done by Weber and about ten years ago our group of radiologists set out to investigate this problem. We did some basic research into the problems of preparation of the patient for the examination, type of contrast medium, roentgenographic technique, and conduct of the roentgenoscopic part of the examination. We were able to standardize the examination so that it would routinely be satisfactory in 80 per cent or more of all patients at the first examination. This technique is reported in detail elsewhere.[21] I would like to add, however, that apparently the reason for past failures has been the neglect on the part of the examiner to pay proper attention to such seemingly minor matters as type of barium suspension, temperature of this material before use and speed of the examination.

As more physicians became adept at the double contrast examination, the problem of differentiating true from false polyps became very real. No satisfactory proof of the

nature of these troublesome false shadows had been offered. Our group of radiologists has reported in detail on the nature of these false polyps[22] and also on some experimental proof with simulated colons and in the living patients.

Once the physician has mastered the double contrast procedure he is confronted with the problem of when to use it to best advantage.[23] You will recall that I said the double contrast procedure, properly done, was diagnostic in 80 per cent or more of patients. In this 15 to 20 per cent, the cecum and or ascending colon is not satisfactorily visualized due to fecal residue or too much or too little barium and air. Other objections to the double contrast procedure are the roentgenographic erasement of early ulcerative changes and the inability to consistently visualize the terminal ileum. In early chronic ulcerative colitis the roentgenologist may often find irritability and slight narrowing of a segment of the colon and then note abnormal changes in the mucosa on the roentgenogram made after evacuation of the opaque medium. In these instances the double contrast examination will show no roentgenographic abnormality because the air will distend the colon to its normal size and the mucosal detail will be lacking (Fig. 3).

The advantages of the single contrast method are well known in that it is most satisfactory for the detection of disease of the right colon and terminal ileum as well as any roentgenologically recognizable inflammatory disease of the colon. The main advantage of the double contrast procedure is that it is most efficient for the detection of intraluminal tumors. The unfortunate fact is that both examinations cannot satisfactorily be done at the same time and still maintain the highest diagnostic value of each. Whether or not all patients should have both examinations is a most difficult problem for two separate examinations entail added discomfort to the patient and raise the problem of cost.

Numerous attempts at a satisfactory compromise have been made. It is possible to do the double contrast examination as the primary procedure, inspect the resulting roentgenograms and, if satisfactory, do the single contrast study a few hours later. The reverse of this procedure is unsatisfactory for barium may be in the terminal ileum or not completely expelled from the colon and thus prohibit completely diagnostic double contrast roentgenograms.

Many radiologists have used the single contrast method with multiple compression spot films in an effort to demonstrate polyps but this method cannot be applied to the entire colon for certain areas cannot be compressed adequately and a large number of roentgenograms are necessary.

Another compromise procedure is the use of tannic acid in the barium suspension.[35] This enables the examiner to adequately roentgenoscope the entire colon and, if possible, the terminal ileum. About the time that the roentgenoscopic examination is completed, the tannic acid causes a marked contraction of the colon. Roentgenograms made after evacuation show the colon mucosa well and if an intraluminal lesion of sufficient size is present it may be revealed as a sausage-shaped swelling. I do not believe this method is as reliable for the demonstration of small polyps as the double contrast method.

The use of a barium suspension of less than normal density has been advocated in an effort to reveal polyps by means of the penetration of the solid column of barium by normal roentgenographic exposure. Overlapping of loops of colon and the presence of fecal material make this procedure of less value than the double contrast. Gianturco[14] has reported on the aid of a relatively high kilovoltage exposure with the same idea in mind, but my objection to these compromise procedures is that, while the radiologist can often demonstrate a polyp, he is not always able to assure the surgeon that no others are present.

Templeton and Addington[28] roentgenoscope the colon completely and, by means of a syphon device, empty a segment of the colon, immediately inject air and take spot

films of the double contrast area. This procedure is repeated throughout the colon.

Since our group has seen nothing as satisfactory as the double contrast examination and since we are convinced of the value of the single contrast procedure we have attacked the problem of dual examination from the clinical side.

As has been demonstrated by numerous autopsy studies, polyps of the colon are not uncommon and their incidence increases with the age of the patient. It may be safely stated that about 12 to 14 per cent of all patients over the age of forty have one or more polyps in their colon. These polyps are invariably adenomas and many show early malignant change. Broders[3] is of the opinion that a truly benign adenoma of the colon is a quite rare finding. Buie[5] has reported that all polyps of the colon are cancers or will become cancers if they are not destroyed and the patient lives long enough. Bockus[2] states that 70 per cent of all colon polyps are within the reach of a 10 inch proctoscope. With these facts in mind, we carried out a "polyp hunting" trial on 1,500 patients.[24] About 500, or one-third, of these patients gave a history of some type of bright red or dark bleeding from the rectum, polyps found by proctoscopic examination or a history of polyps previously discovered or removed. In this group, our double contrast examination showed 5 per cent of the patients to have one or more polyps above the proctoscopic reach. Of the 1,000 patients who did not have one of these three reasons for having the double contrast examination made we found only 0.4 per cent to have polyps. We therefore may conclude that by close correlation between the referring physician and radiologist the problem of dual examination may be greatly minimized.

Now, the reason for all this concern over technique, procedure and choice of method is that the main limiting factor in greatly increasing the cure rate in cancer of the colon is early diagnosis. It is very possible that a large cancer of the colon begins as a small polyp and, if this is true, there is no reason why the cure rate cannot be increased from 30 to 40 per cent to 80 per cent or above if the patient presents himself early enough and if the radiologist and clinician are "polyp conscious."

DEVELOPMENT OF DIAGNOSIS OF COLON LESIONS

Those who have been and are concerned with the roentgenologic diagnosis of colon diseases are fortunate for, compared to the lungs, relatively few diseases cause organic change in the colon. In the development of diagnosis of organic disease of the colon, the pioneers were concerned chiefly with formulating criteria for the diagnosis of cancer and its differentiation from a purely inflammatory process. This was by no means easy for them and even today it can be a problem. Their written description usually mentioned an irregular filling defect and obstruction as the primary signs and palpable mass or fixation due to perforation as secondary signs. Again it remained for Weber[31] to correlate the work of those before him, add his own observations and then prepare criteria for the diagnosis of malignancy which have served most adequately.

The typical roentgenologic findings in cancer of the colon are an intraluminal polypoid tumor of any size, or an annular constricting lesion, usually less than 6 cm. in length and sharply demarcated both proximally and distally from the normal colon. As a general rule, the annular lesions and polyps are in the left colon while the large bulky polypoid tumors are in the right colon (Fig. 4).

Weber[32] noted that at times certain cancers of the colon varied from the typical appearance in that the signs of cancer were present but the lesion was considerably longer than expected. These cases were surgically proved to be cancer with a large extracolic mass due to perforation. In 1950 our group of radiologists[25] decided to investigate 500 consecutive cases of cancer of the colon seen at Scott and White Clinic in an effort to determine the role of the roent-

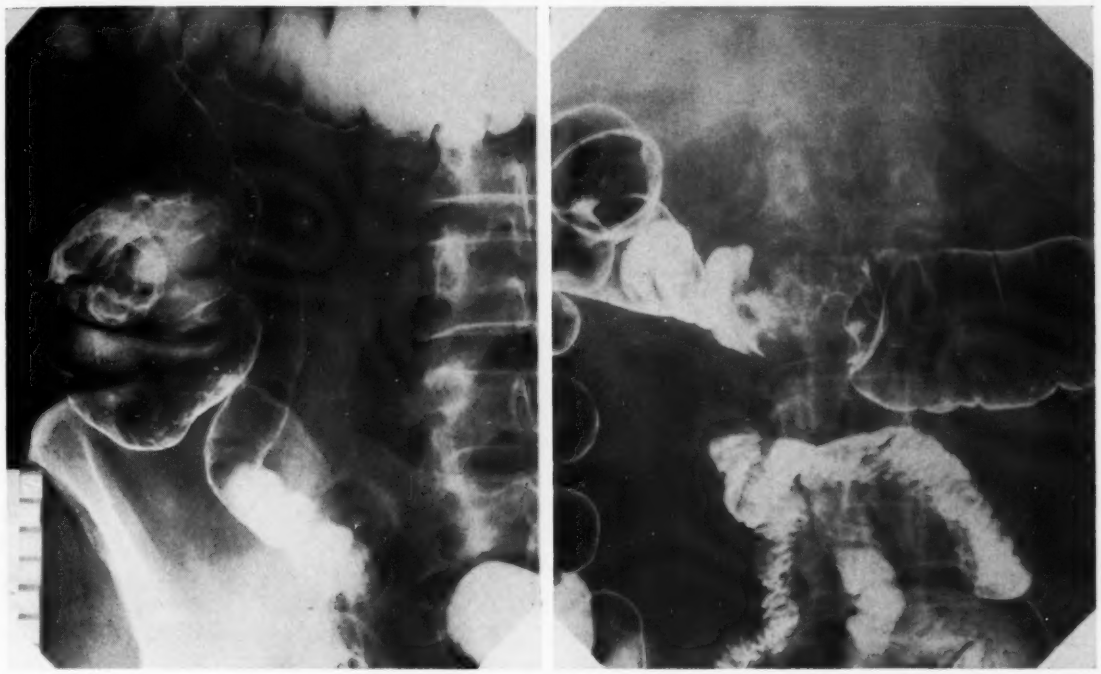

Fig. 4. Large intraluminal polypoid carcinoma in the ascending colon and a typical annular carcinoma in the mid-transverse colon. In the latter instance, note the sudden change from normal to abnormal at both ends of the lesion, the short irregular canal of the lesion and the attempt at intussusception at both ends.

gen examination in the diagnosis of chronic perforation.

We found that in 80, or 16 per cent, of these cases, mention of perforation was made by the roentgenologist, surgeon or pathologist. Of these 80 cases we had direct roentgenologic evidence of chronic perforation in 20 per cent for there was a typical carcinomatous defect plus a fistula to some adjacent tissue or organ. We examined the remaining gross specimens and found that 52, or 10 per cent, were suitable for study. The outstanding pathologic finding was, of course, a mass outside the plane of the intestinal wall. The mass was due to the perforation and in half of the cases was composed almost entirely of carcinomatous tissue, while in 25 per cent the mass was composed of about half carcinoma and half inflammatory tissue. The remaining 25 per cent were grossly inflammatory only but undoubtedly contained microscopic evidence of carcinoma in some instances. We did not carry out extensive microscopic studies in these cases for the roentgen findings we were interested in are caused by gross changes.

This mass extended either cephalad or candad so that it compressed normal colon in all but 20 per cent of the cases. It was easy to see that this extrinsic pressure was responsible for the atypical carcinomatous defect on the roentgenogram. We then measured the length of the roentgenographic defect in 200 cases of nonperforated carcinoma of the colon and found that the average was just under 4 cm. In the 80 per cent of perforated carcinomas where the mass extended up or down the outside of the intestinal wall the roentgenographic defect measured over 6 cm. in length at a minimum and 16 cm. as a maximum (Fig. 5).

Thus we see that the radiologist has both direct and indirect signs to facilitate a diagnosis of chronic perforating carcinoma and should only fail when the extrinsic mass is very small or extends directly out into the mesentery and not up or down the normal colon wall or when the perforating lesion is present in the cecum.

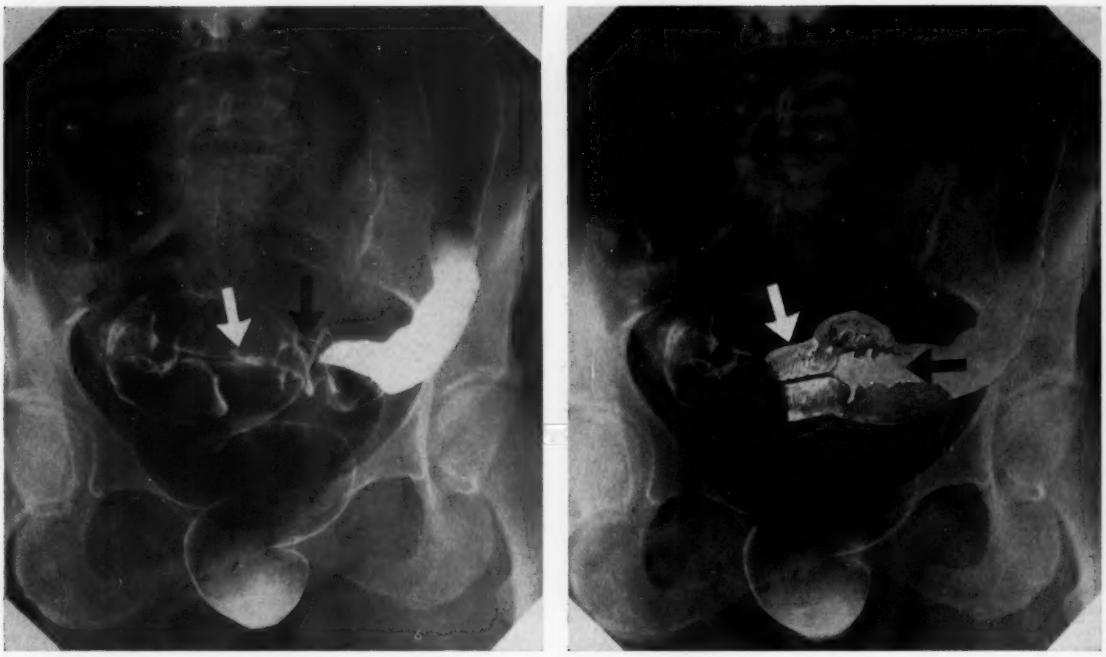

Fig. 5. Typical carcinoma of the sigmoid, but note the tapering proximally. This sign of perforation is proved by the artist's superimposition of the pathologic specimen on the original roentgenogram. The white arrows point to the carcinoma while the black arrows locate the defect due to chronic perforation.

INFLAMMATORY TUMEFACTIONS

Carcinoma is by far the most common tumor of the colon but inflammatory tumefactions occur sufficiently often so that they are important in differential diagnosis. As we have noted, the roentgen criteria for carcinoma of the colon are pathognomonic, hence when a filling defect is found in the colon and evidence of carcinoma is not present the only alternative diagnosis is a nonneoplastic tumefactive lesion. To this exclusion diagnosis may be added the facts that these benign lesions are usually longer than a carcinoma, taper at both ends and have intact but distorted mucosal markings.

These lesions are diverticulitis, hyperplastic tuberculosis, idiopathic ileocolitis, amebiasis and certain fungus infections. Lesions with a similar roentgen and pathologic appearance may be caused by extension of an inflammatory process from some contiguous organ.

Diverticulitis is, of course, the most common of this group of lesions and was recognized by roentgenologic methods early in this century. Hickey, Carman and others were familiar with this entity and were successful in making the diagnosis when there was a persistent narrowing of a segment of the colon (usually the sigmoid) accompanied by numerous barium-filled diverticula (Fig. 6).

Brown and Sampson in 1916 reported on the roentgen findings in intestinal tuberculosis. Their work was conducted on patients with active pulmonary tuberculosis at the Trudeau Sanatorium in Saranac Lake, New York. Because of their class of patients, Brown and Sampson did not have much difficulty with differential diagnosis but reported that irritability of the terminal ileum and right colon, as noted by the barium meal examination, and irritability plus a rather long irregular filling defect, as noted by barium enema study, were rather constant findings in patients with pathologically proved tuberculosis of these segments of bowel.

Depending on the reaction of the bowel

Fig. 6. Advanced diverticulitis with a fixed deformity. Double contrast studies show no intraluminal tumor.

to the invading organism of tuberculosis, the pathologic process may be entirely ulcerative or hyperplastic or a combination of both. These findings will be mirrored in the roentgenographic image and the examiner can then classify the involvement as a benign tumefaction or a chronic ulcerative colitis.

These same roentgenologic findings are relied on today and, when coupled with a roentgenogram showing active pulmonary tuberculosis, are quite accurate provided that none of the signs of malignancy are found.

In contrast to tuberculosis of the bowel, amebiasis does not involve the small intestine, but, other than this, these two lesions may be grossly and roentgenographically identical (Fig. 7). The other benign tumefactive lesions are rare and differential diagnosis cannot be made by roentgenologic methods alone.

ULCERATIVE DISEASE OF THE COLON

In 1914 Schwarz of Vienna described a few cases of colitis and classified them as chronic catarrhal, mucous and ulcerative. Carman found that in the so-called catarrhal and mucous colitis the roentgenologic findings were either within normal limits or not diagnostic. Only in the true cases of chronic ulcerative colitis was he able to obtain consistently positive roentgen findings. Following Carman's time, Bargen, Buie and Weber[33] studied their cases of chronic ulcerative colitis in great detail. The roentgenologic findings consist of narrowing of the lumen, shortening of the length and destruction of the mucosa. These may be present from a minor to a severe degree and the roentgenologist must classify the cases for diagnosis according to the site of primary involvement, distribution and severity of signs.

Roughly three-fourths of all cases of chronic ulcerative colitis have involvement

Fig. 7. Contracted cecum due to fibrosis from a long-standing amebiasis.

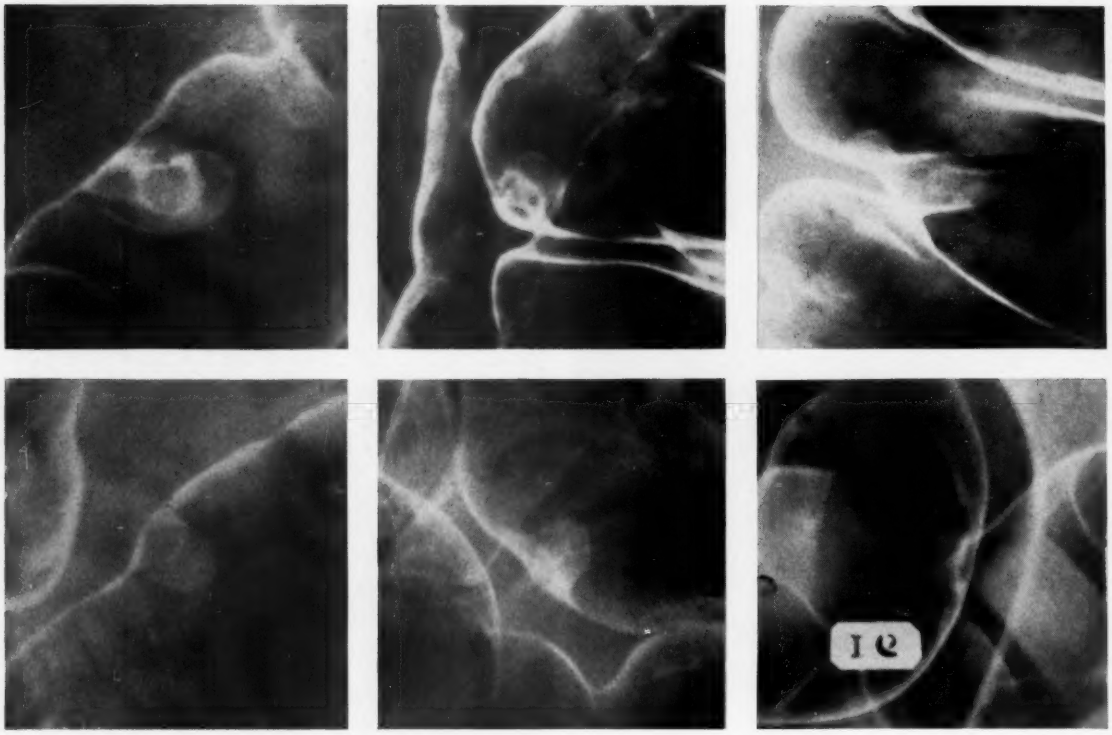

Fig. 8. Six small polyps, all early carcinoma, from 6 different patients.

of the rectum, apparently begin there, and may or may not spread proximally to involve the entire colon and terminal ileum. The remainder of the cases may be classified as to those with atypical distribution in which one or more segments are involved with relatively normal bowel between and those for which some definite etiological agent may be determined.

From a roentgenologic standpoint the following classification is convenient:

Type 1: Synonyms for which are idiopathic ulcerative colitis, Bargen's ulcerative colitis, common ulcerative colitis. Three-fourths of all cases are of this type.

Type 2: This is the segmental ulcerative colitis of unknown etiology. Usually only one segment (transverse, descending or portion of) is involved and, as a rule, the rectum is spared.

Type 3: All cases of chronic ulcerative colitis for which a definite etiological agent can be found. These are tuberculosis, amebiasis, lymphopathia venereum, bacillary dysentery and deficiency diseases.

MEGACOLON

One of the striking advances made in connection with diseases of the colon is the completely new concept of diagnosis and treatment of megacolon as presented by Swenson, Neuhauser and Pickett[27] in 1949. The absence of the myenteric plexus in megacolon has been noted since early in this century[34] but it remained for Swenson, Neuhauser and Pickett to show that the dilated colon was essentially normal and that by roentgenologic examination an area of narrowing could be demonstrated in the rectosigmoid just distal to the dilatation. The colon distal to the dilatation does not contain the myenteric plexus so that orderly passage of bowel content is interfered with and a physiologic obstruction occurs. Cure is effected by surgical removal of all the colon distal to the dilated portion and insertion of the dilated sigmoid into the anal sphincter.

POLYPOID DISEASE

As has been shown, Fischer initiated an excellent method for the detection of intraluminal neoplasms of the colon, Weber modified and improved this procedure and further work has been done to make the roentgenologic recognition of polypoid disease a relatively easy task.

Polypoid disease may be classified as follows:

1. Primary
   A. One or more adenomas anywhere in the colon but most common in the rectum and decreasing rapidly and proportionately as the right colon is reached (Fig. 8 and 9).
   B. Polypoidosis—A diffuse hyperplasia of the entire colon mucosa. Superimposed on this are multiple true adenomas (Fig. 10).
2. Secondary: The polyp-like hyperplasia of mucous membrane seen as a healing stage of chronic ulcerative disease. Superimposed on this hyperplasia, true adenomas may, at times, occur.

Fig. 9. Multiple polyps in the left colon and an annular carcinoma in the sigmoid.

Concomitant with advances in the conduct of the colon examination have been advances in the efficiency of roentgenologic equipment and roentgen technique. Fuchs[13]

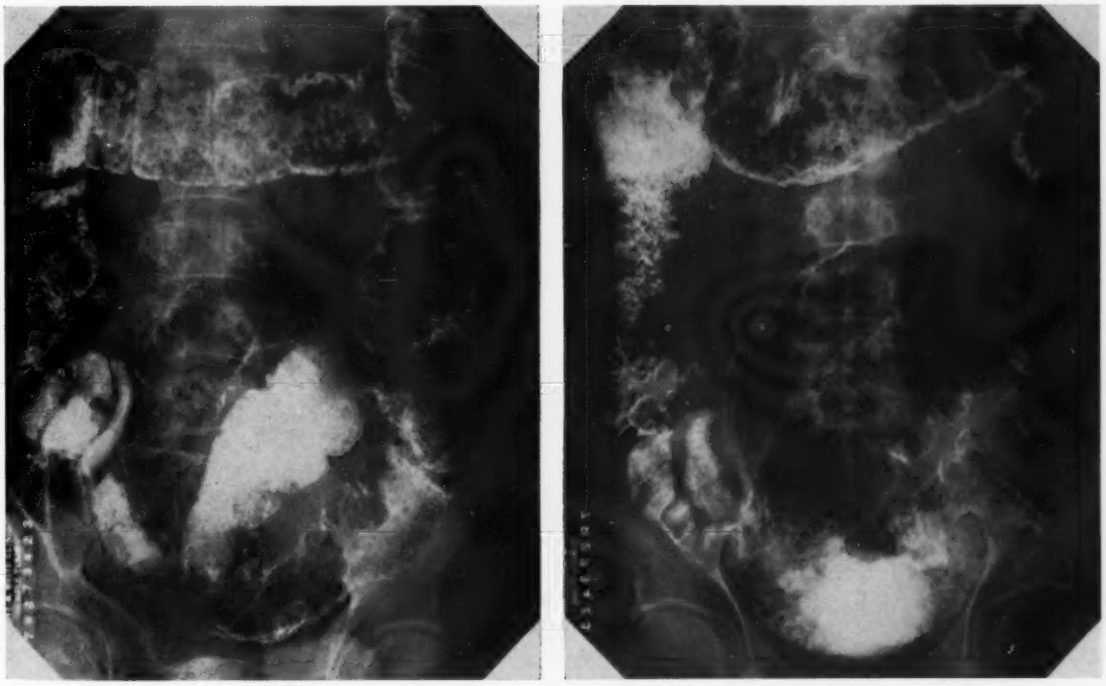

Fig. 10. Polypoidosis with superimposed adenomas. Note the granular appearance especially in the ascending portion.

has advocated the use of a higher than normal kilovoltage for the exposure of most parts of the body. Foegelle[12] of our group has adopted this technique for the colon examination and I believe the resulting roentgenograms have an increased diagnostic yield.

In conclusion, the radiologist has at his command a very useful examination for the detection of all organic diseases of the colon. By understanding the gross pathologic changes and correlating them with the findings of the roentgenologic examination, much can be contributed to the diagnosis and medical or surgical treatment of the patient.

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INDICATIONS FOR THE DOUBLE CONTRAST COLON EXAMINATION*

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CONSIDERABLE confusion exists in choosing the method of roentgen examination of the colon. The double contrast method is the only reliable procedure for determining the presence or absence of small neoplastic lesions, but this examination fails to be of value in certain inflammatory diseases.[4] At times, the double contrast examination fails to be diagnostic in regard to a possible lesion of the right colon or terminal ileum. The examiner is therefore confronted with the problem of doing either the single or double contrast examination, or both. For utmost accuracy, both examinations require two separate procedures with separate preparation and a time interval of at least one day. This may be economically unsound and often unnecessary if there is close cooperation between the radiologist, proctoscopist, and referring physician.

As has been demonstrated by numerous autopsy reports, polyps of the colon are not uncommon and their incidence increases with the age of the patient. It may be safely stated that about 12 to 14 per cent of all persons over the age of forty years have polyps of the colon.[2] These polyps are invariably adenomas and many show early malignant change. In patients with a large carcinoma of the colon, 25 to 30 per cent will have associated polyps, usually near the cancer site.[3] Buie makes the statement that all polyps of the colon are cancers or will become cancers if they are not destroyed and the patient lives long enough.

About 70 per cent of all colon polyps can be visualized with a 10 inch proctoscope, and it is interesting to note that about 70 per cent of all frank colon cancers are also found in this region.[1] These well known facts make the radiologist feel lost when the colon examination is not preceded by an adequate proctosigmoidoscopic examination. The responsibilities of the radiologist are further emphasized by the findings of Swinton *et al.*[5] They reported multiple involvement in 42 per cent of all patients with polyps.

With the exception of bleeding, it is unlikely that any polyp will cause symptoms unless its size becomes sufficient to interfere with the normal peristaltic movement of bowel content. We may arbitrarily divide all polyps into two groups: those more and those less than 1 cm. in diameter. Those less than 1 cm. in diameter can only be demonstrated consistently with the double contrast examination as developed by Weber of the Mayo Clinic.[6] Those larger than 1 cm. may be demonstrated by roentgenograms or by roentgenoscopy when the involved area is palpable. We feel that the double contrast examination is more reliable than any other method, including roentgenoscopy, for the detection of a polypoid lesion of any size.

For many years we used the following as indications for the double contrast examination: (1) any amount of bleeding (bright red, or dark), (2) polyps found at proctoscopic examination, (3) history of polyps previously discovered and/or removed. As we became more adept in employing the double contrast examination we obtained a higher yield of positive findings. We then began to wonder whether it might not be best to do the double contrast examination on all patients with the hope of finding completely unsuspected polyps.

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INCIDENCE OF UNSUSPECTED POLYPS

We conducted this study during a recent period of five months. Of over 2,000 colon examinations, the double contrast procedure was used in 1,500 instances. Approximately one-third of these patients had one of the above mentioned reasons indicating the double contrast examination. Hence, in 1,000 patients, we used the double contrast examination in an effort to find *unsuspected* polyps. We found, and subsequently proved, a single small polyp in each of 4 patients, 0.4 per cent.

Of the 500 patients having one of our three indications for the double contrast examination, 25 patients, 5 per cent, had polyps above the proctoscopic limit.

Twenty per cent of the 1,500 double contrast examinations were not diagnostic as far as the ascending colon was concerned. Fecal residue and too much or too little barium and/or air were the reasons for this failure. Of course, a disease of the terminal ileum seldom can be detected by the double contrast examination alone.

In view of postmortem studies revealing the presence of colon polyps in about 12 per cent of all persons over the age of forty and the fact that 30 per cent of polyps are above the proctoscopic limit, we expected to find an incidence of 4 per cent in patients of this age group examined by the double contrast method. By 1,500 double contrast examinations, we found polyps above the proctoscopic limit in 29 patients, 1.9 per cent. It is difficult to estimate the accuracy of the double contrast procedure on this basis alone for many of our patients were under forty years of age.

Roentgenoscopy and subsequent roentgenograms are absolutely necessary for the detection of a lesion of the terminal ileum, cecum, or ascending colon. The routine double contrast examination is therefore not the method of choice when the clinician has any reason to suspect disease in these segments. As one of us (C.A.S.) has reported, the double contrast examination will erase mucosal detail and distend segments of the colon involved by a relatively mild inflammatory process. For these reasons when the referring physician suspects an inflammatory disease of the colon, the double contrast procedure should not be used as the primary method of examination.

The referring physician should be aware of the advantages and disadvantages of the

TABLE I

CLINICAL INDICATIONS FOR THE COLON EXAMINATION

Column 1		Column 2		Column 3		Column 3 (cont'd.)	
Reason	No.	Reason	No.	Reason	No.	Reason	No.
Pain, right side	389	Bleeding (any type or amount)	529	Constipation	900	Diverticulosis	96
Mass	186	Polyps (or history of)	373	Cramping, lower abd.	227	Colitis	88
Diarrhea	479			Pain, left side	205	Obstruction	79
Anemia	46			Cramping, upper abd.	250	Indigestion	76
Amebiasis	50			Irritable bowel	175	Weight loss	68
Chronic ulcerative colitis	50			Carcinoma	184	Postoperative check-up	69
				Gas	153	Change in bowel habits	68
				Irritable colon	116	Others	144
Total	1,200		902				2,898

double contrast examination, and by close cooperation with the radiologist, the best diagnostic method may be chosen. In an effort to evaluate the clinician's purpose for ordering the colon examination, we investigated the main clinical reason in 5,000 instances (Table 1).

The clinical reasons in column 1 indicated complete roentgenoscopy and roentgenograms of the right colon and terminal ileum in 1,200 instances. In column 2 there were 902 reasons from 5,000 requests which definitely indicated the double contrast examination. In column 3 there was a heterogeneous group of clinical reasons for the colon examination. In this group it is advisable for the radiologist and clinician to predetermine whether or not to employ the double contrast examination, bearing in mind that only 0.4 per cent will disclose polyps.

CONCLUSIONS

1. Through examination of 1,000 patients by the double contrast method, we found completely *unsuspected* polyps in only 0.4 per cent.

2. Since the ascending colon was inadequately visualized in 20 per cent of these patients, it was apparent that the double contrast examination should not be used as a routine procedure because of the possibility of missing a lesion of the terminal ileum, cecum, or ascending colon.

3. When the referring physician indicates the possibility of disease of the terminal ileum, right colon, or inflammatory disease, then complete roentgenoscopy, and roentgenograms before and after evacuation are indicated.

4. All other patients may be examined by the double contrast method but if it is necessary to adequately visualize the cecum and ascending colon re-examination will be necessary in about 20 per cent.

5. As far as polyps are concerned, the double contrast examination will produce a diagnostic yield of about 5 per cent in all patients who have any type of rectal bleeding, polyps found at proctoscopic examination, or a history of polyps previously found or removed.

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DISCUSSION

Dr. Frederic E. Templeton, Seattle, Washington. Drs. Stevenson and Wilson have presented an excellent, brief and informative review of their experiences with the double contrast examination of the colon.

We in Seattle agree with Dr. Stevenson that both the single and double contrast examinations are ideal for the complete colonic survey. We believe, however, that the examinations should be done routinely. In a little over 10,000 combined examinations we have found both benign polyps and small malignancies in patients having no clinical evidence of disease other than vague abdominal distress. I cannot give you an exact figure since all patients suspected of harboring a lesion were not brought to surgery. The figure is small. Dr. Stevenson gives 0.4 per cent. We think this figure is significant and cannot be ignored.

We have tried to circumvent the economic objections of increased time and expense for the dual examination by combining all procedures into one combined operation by using a system of barium mixture injection, drainage, air injection, spot and survey films, and a post-evacuation film. This is accomplished by a special valve which Dr. Addington and I described in the *Journal of the American Medical Association*, 1951, Vol. *145*, pp. 702–704.

I think it is proper that we should analyze some of the techniques proposed for the demonstration of small colonic lesions and try to see where we stand.

Drs. Gianturco and Miller, in their exhibit, showed excellent examples of polyps recorded with high voltage. No air was used. As I viewed the exhibit I wondered if high voltage was the whole answer, for I noticed that in most of the roentgenograms the section of colon shown was not completely distended. In response to a question, Dr. Miller told me that the enema injection was stopped when the head of the column reached the splenic flexure. Barium which coasted into the transverse colon relieved the distention of the lower colonic segments. This decreased the volume of barium around the polyps, thus facilitating visualization.

We do the same thing in another way. When the enema reaches the mid-transverse colon or hepatic flexure, drainage is instituted. The collapsing lower segments of the colon are recorded on spot films. This is a routine procedure. We use 90 kv.

Dr. Kaplan, at Stanford, injects a few ounces of thick colloidal barium mixture and forces it to the cecum by injecting air, and by turning the patient into different positions. A. W. Fischer, the father of the double contrast examination, also used this method. We also force the barium to the cecum after filling the colon to the mid-transverse or hepatic flexure with air injection after recording spot films of the sigmoid and descending segments during drainage. Dr. Stevenson tells me that he does the same thing.

Frequently, the ileum fills so that we are able to record the cecum and ileum routinely on spot films. Here we meet in part with Dr. Stevenson's second objection to combining the two examinations.

Sometimes the air, during injection, passes ahead of the barium column, but by turning and tilting the patient the barium can usually be flowed into the cecum and ascending colon and spread over the surface. If this procedure cannot be done, a re-examination is indicated later. The number of failures is small.

Actually, those of us who search for small lesions find that our methods are not too far apart. Whether we have improved on the method described by Fischer and popularized by Harry Weber years ago, I do not know. This I know: In our search to improve the examination of the colon we have become more conscious of the dangers that lie in not finding the small lesions.

Our big problem now is to improve and simplify the preparation of the colon. Dr. Stevenson gives a figure of 80 per cent efficiency. Fecal material that is most troublesome lies in the cecal ascending segment and calls for additional preparation and re-examination. The lesions we miss are mostly located in this region —not because we do not separate the two phases of the examination as Dr. Stevenson suggests, but because of poor preparation and residual fecal masses that hide the lesions.

I do not think there is any particular magic in any particular barium preparation. We have had better luck with the thicker than the thinner mixtures. We have been experimenting with wetting agents in the barium mixture. It seems to help, but we are not yet ready to advocate that the procedure has real merit, or become salesmen for a particular soap company who sells detergents, all of which are wetting agents—some toxic, some not.

The answer to success in these procedures lies in the man more than in the tools.

We must also recognize that in gastrointestinal work we are returning to film diagnosis. We are learning that the fluoroscope is a fine instrument for detecting the larger lesions, but a crude one for the smaller. We will always need the fluoroscope to aid us to determine filling, to determine position, and to guide us in spot filming, but the actual diagnosis of the small lesions is usually made from the roentgenogram.

I ask Dr. Stevenson the following questions:

1. Do you render an opinion on the rectum, and do you follow a proctoscopic examination immediately with a barium enema?

2. Have you encountered any polyps which do not coat with a barium mixture?

3. Do you believe that when you say a colon is normal that it is? In other words, can you be sure in the ideally prepared patient that no polyps are present?

4. In your search for these small lesions are you more apt to over-call than under-call lesions?

Dr. Harry M. Weber, Rochester, Minnesota. I am glad that Drs. Stevenson and Wilson were given an opportunity to present this

paper at this time and in this place. One can gather from what they said that the double contrast procedure is not readily adapted to roentgenologic surveys. It is a technique designed primarily to provide assurance and confirmation of the existence and anatomic features of a lesion which the standard examination of the large intestine has already revealed, but often less clearly and convincingly. By the term "standard examination" I mean the roentgenoscopic and roentgenographic examination of the colon during administration of the opaque enema and after that enema has been expelled in the natural way, that is, by defecation.

I venture to say that the polypoid lesion of the colon which is large enough to be demonstrated convincingly by any roentgenographic procedure can be identified or at least suspected at the roentgenoscopic examination of the colon. Diagnostic roentgenologists should, I think, strive earnestly for that much competence in roentgenoscopy. This statement must not be construed to mean that no macroscopic polypoid lesions are overlooked at the standard roentgenoscopic examination; I wish only to emphasize once again that this part of the examination is basic and cardinal, and that, as of this moment, no good substitute for it has been developed. A notable limitation of this standard examination is encountered in the congenital type of multiple polyposis, in which the intestinal mucous membrane is studded with literally myriads of tiny, small and large adenomatous polyps. The tiny and smaller ones may easily be overlooked, mostly because the examiner is so likely to be distracted by his preoccupation with the larger ones. The double contrast examination is singularly well adapted to the demonstration of the status of the entire intestine in cases of this disease. I know of no other roentgenographic procedure, including "spot" roentgenography, which makes this demonstration so accurately and so dramatically.

In any consideration of the accuracy of a diagnostic procedure, it is quite as important to be as attentive to the lesions whose existence was not discovered or suspected as to those that were discovered and later found also at operation or necropsy. Surgeons have come to place so much reliance on roentgenologic diagnosis that it is often difficult to persuade them to undertake operation when convincing roentgenologic evidence of abnormality has not been produced. The public has somehow acquired a similar attitude. These are reasons why our failures to uncover significant lesions, particularly those not manifest clinically by threatening or alarming symptoms, are not as often brought to light as they probably should be if we are to make a fair appraisal of our diagnostic efficiency. That some polypoid lesions, especially those 1 cm. or less in diameter, are being overlooked and will continue to be overlooked is, I think, inevitable. There are so many factors which singly or in combination can vitiate our entire procedure that I simply cannot hope to achieve a competency for our approach that will compete with direct observation at proctoscopy, at colotomy or at necropsy.

I think it is important, too, to remember that there are other important abnormalities of the colon than intestinal polyps. Can we afford to make routine and exclusive use of a procedure whose chief and almost exclusive advantage is the dramatic demonstration of the nondeforming intraluminal polypoid type of lesion? I think not.

For the patient who has a lesion in the right side of the colon, that portion of the intestine is much more important than the left. Our standard examination must include a thorough, convincing roentgenologic exploration of the entire large intestine, including ideally a substantial part of the terminal portion of the ileum. This means that in many instances two sessions will be necessary to get a complete and convincing answer to a given clinical problem related to the large intestine.

It makes me happy to be able to subscribe to the attitude Drs. Stevenson and Wilson have developed toward the examination of the large intestine as well as to its conduct as they have described it today.

Dr. Stevenson (closing). I have been asked to discuss our technique for the double contrast colon examination, whether we regard the field of diagnosis to include the rectum, and the accuracy of the double contrast examination.

None of these subjects described concern the paper presented here today, but I will briefly answer the questions to the best of my ability.

(1) Our double contrast technique is that described by Dr. Weber of Rochester, Minnesota. In brief, this consists of running the barium suspension, under fluoroscopic control,

to somewhere around the mid-transverse colon and then permitting the patient to evacuate the enema. Immediately air is introduced, under fluoroscopic control, until the entire colon is distended to approximately its normal size. Prone and supine stereoscopic films are then made as quickly as possible. For certain incapacitated adults and children we use the so-called "one way" method. This consists of stopping the flow of barium just short of the splenic flexure and immediately introducing air and then proceeding as described above.

(2) We do not regard the field of roentgen diagnosis as including the rectum. Pathologic changes visualized by direct vision can certainly be better interpreted than that of roentgen shadows.

(3) We believe that the double contrast examination of the colon is quite accurate when a technically good set of roentgenograms can be obtained. I would estimate that less than 1 per cent of small polyps fail to coat with barium.

THE ROENTGEN FINDINGS IN STRANGULATING OBSTRUCTIONS OF THE SMALL INTESTINE

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INTRODUCTION

FURTHER reduction in the mortality rate of acute intestinal obstruction must come from better management of the two conditions which cause most present-day deaths: strangulating obstructions and markedly distended late cases of simple obstruction. Better techniques of surgical decompression will permit surgeons to save even late cases of distention.[7,8,9,32,33] The mortality of strangulating obstructions, however, can be reduced only by earlier diagnosis.

It is the common practice to operate upon most cases of intestinal obstruction as soon, after the diagnosis is made, as the patient can be prepared to withstand the surgical procedure. The diagnosis of mechanical intestinal obstruction without elaboration is, therefore, specific enough in most instances. Two groups of problem cases remain. The first group contains those cases of strangulating obstruction in which not only is the strangulation not revealed but the signs of obstruction are disguised. The second group is composed of those cases which should be treated non-operatively if possible and would be so treated if it were certain that strangulation was not present. This group includes the poor operative risks, the partial small intestinal obstructions (especially if there have been several previous operations), and the inflammatory lesions in which an obstructive component is present. Dennis[7] believes that 35 to 40 per cent of small intestinal obstructions could well be treated by non-surgical means if we could but select the proper cases with unfailing accuracy.

DEFINITION

An obstruction is considered to be of the strangulating type if, in addition to a block in the intestinal continuity, there is evidence of compromise of the blood supply. The degree of compromise varies from slight compression of the mesenteric veins, manifested at operation by a slight bluish discoloration of a segment of the bowel, to frank hemorrhagic infarction and gangrene.[13] In most cases of internal strangulating obstructions, a "closed loop" is produced. The bowel lumen is narrowed or blocked at two points by a single constricting lesion which also compresses the mesentery and its vessels. The lumen of the bowel between the two points of compression is open. It is possible to have only a partially closed loop with sufficient vascular compression to produce infarction and certainly one can find almost completely closed loops without any evidence of strangulation at all (Fig. 3). The incarcerated loop tends to be fixed in position. Small closed loops are quite fixed while long loops may have considerable mobility.

Strangulating obstructions may result from a volvulus, an incarcerated hernia, passage of the small intestine through an abnormal opening in the mesentery such as is produced by certain surgical procedures, or a twisting of the intestine around a band such as a Meckel's diverticulum. The most common cause is the presence of adhesive bands at two separated points producing a double obstruction.

PATHOLOGIC PHYSIOLOGY

Whatever the specific cause of the incarcerated or twisted loop, there are two groups of effects: the first arises because the bowel content has stopped moving forward and the second because the bowel is anoxic, either as a result of passive congestion or of

* Presented at the Fifty-third Annual Meeting, American Roentgen Ray Society, Houston, Texas, Sept. 23–26, 1952.

ischemia. The effects probably develop in somewhat the following manner. The luminal obstruction is followed by an increase in peristaltic activity with concomitant pain. Gas and fluid accumulate above the point of obstruction. If the lumen at the upper end of the incarcerated loop is only partially obstructed gas will enter the loop. Sometimes, possibly because of increased peristalsis above the obstruction or for other reasons not clearly understood, the superior segment of the bowel will be devoid of gas or will contain a surprisingly small amount. The presence of moderate amounts of gas or the presence of fluid plus moderate amounts of gas within the fixed loop indicates the likelihood of an incomplete obstruction. At the same time as the lumen is occluded the mesenteric blood vessels are compressed. The veins are narrowed first, producing a rise in venous pressure but not arterial pressure. For the most part, save for rupture of thin-walled capillaries and veins, extravasation of blood into the lumen of the strangulated bowel and into the free peritoneal cavity is produced early by the elevated capillary pressure working against an impeded venous return. As soon as the venous pressure rises there is progressive anoxia of the intestinal musculature producing first hypermotility and then spasm. This is followed, as anoxia increases, by flaccidity and dilatation. The late result of both the distention and the compromised circulation is a thickened overstretched intestinal wall, deficient in tone and contractility.[3,12] Frank necrosis and perforation of the intestines may supervene.

REVIEW OF LITERATURE

Reinus[26] studied the cases of mechanical small intestinal obstruction resulting from adhesions seen over a ten year period at Lenox Hill Hospital, New York City. He attempted to determine the reliability of the commonly accepted clinical and laboratory evidences of strangulation. The material was divided into simple and strangulating obstructions and the latter were separated into the "imminent strangulations," in which the intestine showed any signs of stagnant anoxia, and the "obstructions with strangulation," in which the strangulating process had terminated in infarction. One might call these early and late strangulating obstructions.

Analysis of the physical findings revealed essentially the same changes as have been emphasized by Wangensteen[32] and grouped as the signs of irritability of the parietal peritoneum. Of the clinical laboratory findings, McKittrick and Sarris[22] stressed the importance of a rising leukocyte count. In Reinus' material, the leukocyte count was felt to be of little help. The results of roentgenologic diagnosis in his series are of great interest. In no case was the presence of strangulation suggested following roentgen examination. In addition, it is noteworthy that while a correct diagnosis of mechanical obstruction was made in 48 out of 51 cases of simple obstruction, even the presence of obstruction, per se, was not evident in 3 out of 6 cases of late strangulating obstruction and in 1 out of 3 cases of early strangulating obstruction.

In the surgical literature little emphasis is placed upon the value of roentgenologic signs of strangulation. Cope[5] (1948), Ferguson[10] (1949), Ficarra[11] (1949) and Cole[4] (1950) among others, have written excellent papers on intestinal obstruction, with attention to the diagnosis of strangulation, without any definite indication that roentgen evidence of strangulation is sought or is of value. Indeed many radiologists have felt with Middlemiss[23] that "the problem of the state of an obstruction, acute or chronic, simple or strangulating, is a clinical entity rather than a roentgenological problem."

Many years ago one of us[28] was impressed with the possibility that roentgen evidence of strangulation might be sufficient to permit the separation of such cases from simple obstruction. Continuing experience suggested that some cases of strangulating obstruction demonstrated a rather localized distention of two segments of bowel. In many instances the gas-filled loops of bowel took on a characteristic appearance which was described as the "coffee bean" sign because the gas-filled lumina were separated by a fairly broad, dense band caused by the edematous bowel walls or possibly by a small amount of peritoneal fluid between the loops of bowel. The presence of fixation, as shown by lack of movement of a loop of bowel

on several films made in different positions, was also emphasized.[27]

Frimann-Dahl in 1944[14] and again in 1951[16] described another roentgen sign. A soft tissue density suggesting a soft tissue mass, caused by intestinal loops almost completely filled with fluid, was considered indicative of strangulating obstruction. He did not believe that localized gaseous distention could occur in a strangulated loop of bowel. In 1949, Crowley and Winfield,[6] in an extensive review, stated that gaseous distention of an isolated loop was almost pathognomonic of strangulating obstruction. They added that the finding might not be recognized because of the presence of other gas-filled loops and that it was therefore better seen early. It was their feeling that "the presence of a single loop, if found together with the clinical diagnostic features, may generally be regarded as the strongest evidence of strangulating obstruction." This was in agreement with the observations one of us made earlier.[28] Berry[2] described essentially the same findings, while Totten[31] discussed and presented an illustration of fluid-filled loops in a patient with a strangulating obstruction. Hunt[18,19] and Lockwood, Smith and Walker[21] noted the absence of normal mucosal markings in a distended segment of small intestine. They stated that, when present, this is a pathognomonic roentgenologic sign of strangulation or embarrassment of the blood supply.

CLINICAL DATA

In order to evaluate the possibilities and limitations of roentgen diagnosis in cases of strangulation, 334 small intestinal obstructions seen between 1937 and 1952 in the University of Minnesota Hospitals were studied. Thirty-four instances of internal strangulating obstructions were found. This is an incidence of 10 per cent compared with 5.5 per cent in Baumgartner's series[31] and 18.5 per cent in Frimann-Dahl's group.[16] Twenty-six cases were available for study and these form the basis of this analysis. There were 21 cases due to peritoneal adhesions, 2 cases in which there were small intestinal volvulus and peritoneal adhesions around an anterior colostomy stalk, 2 cases of volvulus alone and 1 case of jejunal volvulus complicated by the presence of four enteroceles along the antimesenteric border of the jejunum.

TABLE I

ROENTGENOLOGIC FINDINGS IN 26 CASES OF STRANGULATING OBSTRUCTION

Closed loop		15
A. Gas distended ("coffee bean" sign)	7	
B. Fluid-filled ("pseudotumor" sign)	8	
Fixation of loop		13
Loss of mucosal pattern		12
Absence of gas above obstruction		6
Lack of decompression of localized segment following suction		3
Presence of small amount of gas in colon		17

Table 1 indicates the frequency of the roentgenologic signs. In almost 60 per cent of cases the closed loop is demonstrable. Fixation of a portion of the small intestine is noted in 50 per cent and loss of mucosal markings in 50 per cent. Three cases showed only the signs of simple obstruction and in one even mechanical obstruction could not be diagnosed.

ROENTGENOLOGIC SIGNS

The roentgen diagnosis of strangulating obstruction may be missed if the entity is not specifically sought or if one considers that there is a single sign which should be present in every case. Strangulation obstruction is produced by a fairly constant anatomical derangement, the incarcerated or twisted intestinal loop. This, however, initiates physiological disturbances which are progressive or changing in character and varying roentgen signs mirror the various phases of the pathologic process.

The evidence of an incarcerated loop may be of two types. If the loop is only partially closed it will be gas filled or gas and fluid filled. In the horizontal film gas will be seen in the two distended limbs of the incarcerated loop. The gas shadows will be separated by the apposed intestinal walls, probably somewhat edematous, and therefore producing a thicker shadow than normal (Fig. 1, 2 and 3). This has been called the "coffee bean" sign.[28] If the in-

carcerated loop is completely closed it will contain little or no gas. Intestinal gas is either swallowed air (72 per cent), a diffusion product into the intestines from the blood stream, or the result of intestinal putrefaction.[1,32] A completely closed loop obviously will not admit the gas which descends from the upper portion of the intestine and therefore the largest source of intestinal gas is excluded from the incarcerated loop. It will contain, for the most part, only the bloody transudate resulting from the process of strangulation. A

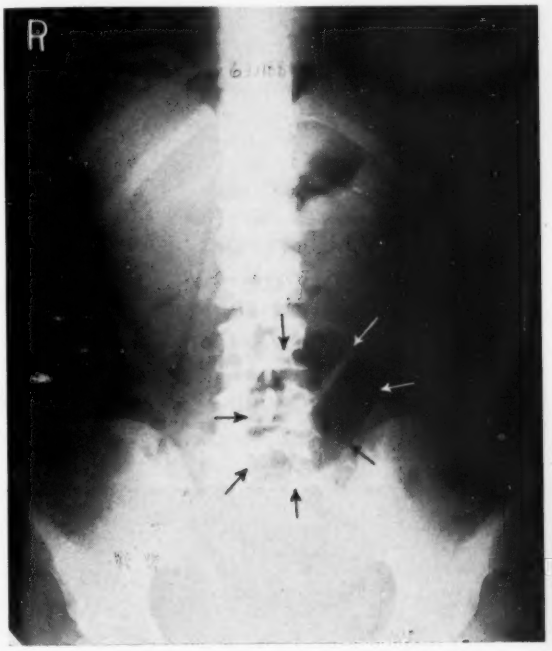

Fig. 1. Typical "coffee bean" sign. A distal loop of ileum was fixed in the lower abdomen by peritoneal adhesions.

small amount of swallowed air may be found in a completely closed loop, if the process of closure developed over a period of time, beginning with a partial obstruction. Roentgenograms of the abdomen will then show the fluid-filled closed loop as a somewhat rounded or oval-shaped soft tissue density (Fig. 4, 5 and 6)—the "pseudotumor" sign.[14] While the "coffee bean" sign is harder to distinguish when there is gas in the superior segment of the small intestine, the "pseudotumor" sign is

Fig. 2. "Coffee bean" sign. The complete absence of mucous membrane pattern in the involved loop is another sign of strangulation.

Fig. 3. "Coffee bean" sign. Operation revealed a gas-distended, incarcerated loop, obstructed at two points by postoperative adhesions, but strangulation had not supervened.

FIG. 4. "Pseudotumor" sign. Operation revealed fluid-filled gangrenous loops of jejunum 22 cm. distal to the ligament of Trietz. The lobulated contour of the fluid-filled loops distinguishes the "pseudotumor" sign from a true tumor.

enhanced by the presence of gas in the upper reaches of the small intestine.

Fixation of the involved loop is the third of the signs usually observed (Fig. 5, 8, 9 and 10). Films should be made with the patient in the erect, supine and lateral decubitus positions in order to bring this out. Lack of movement of the loop is strongly in favor of a diagnosis of closed loop obstruction. In the presence of a large amount of gas in the upper small intestine, fixation may be somewhat difficult to determine. Short incarcerated loops will tend to show a higher degree of fixation than longer loops.

While the normal small intestine shows a continuing autoplastic change in the contour and appearance of the valvulae conniventes, distended small intestine contains fixed semicircular or circular valvulae. When stagnant anoxia occurs there is loss of tone of the muscularis mucosae and the fixed valvulae disappear leaving a smooth or formless intestinal lumen. This is a fourth sign of strangulation and can be demonstrated either within the gas-filled incarcerated loop or within the intestine just above, providing there has been sufficient distention to compromise the intramural circulation (Fig. 2 and 8).

That strangulating obstructions can occur without evidence of abdominal disten-

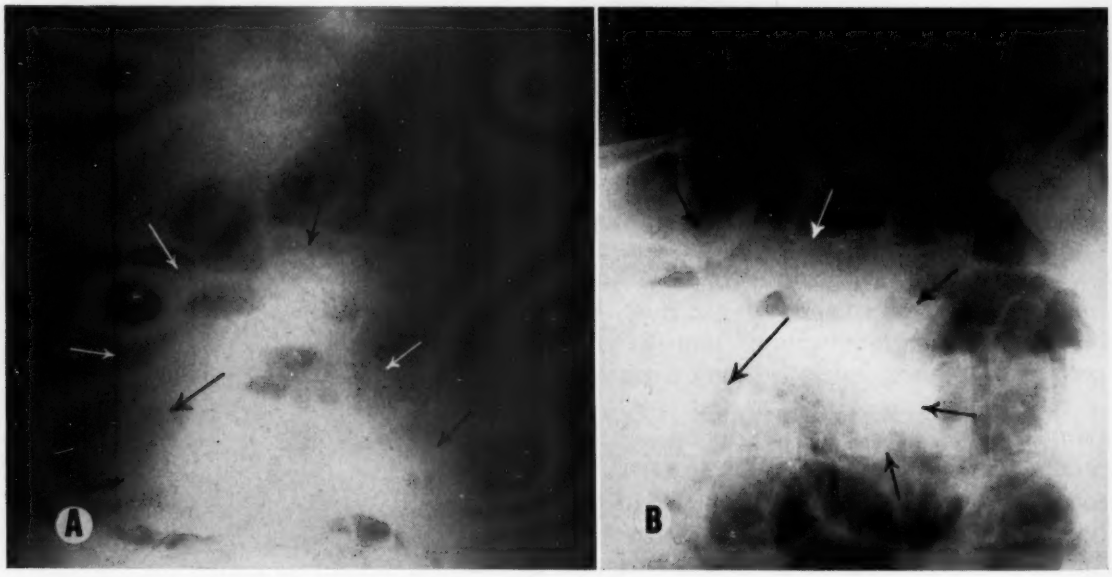

FIG. 5. (*A*) Upright film. Arrows indicate the "pseudotumor" shadow. Central arrow shows a small amount of gas within the fluid-filled loops. (*B*) Left lateral decubitus film. Note relatively unchanged position suggesting fixation of the involved loops.

Fig. 6. Characteristic "pseudotumor" sign. Strangulating obstruction of segment of terminal ileum 45 cm. long was caused by adhesions. Outer arrows indicate fluid-filled loop. Inner arrow shows small amount of gas within loop.

tion has been emphasized by Wangensteen.[32] Reinus' review indicates that while distention was present in 80 per cent of the simple obstructions and 90 per cent of the early strangulating obstructions, it was found in only 40 per cent of the late strangulations. The roentgenologic counterpart of these clinical findings is the absence or scarcity of small intestinal gas above the proximal end of the strangulating loop (Fig. 1, 7, 9 and 10). In the present series this was found six times.

Chesterman[2a] reproduced this situation experimentally in cats and tried to find the explanation. He placed a celluloid window in the abdominal wall of the experimental animals and removed enough omentum to allow a clear view of the small intestinal segments which were to be studied. Strangulation was produced and relieved by means of a 1 cm. wide cloth tape brought out of the abdomen through a stab wound. Here it was fastened over a lead button so that the process could be watched and the degree of strangulation controlled. Pressure was applied gradually over a period of one or two minutes and the degree of pressure was varied in different experiments. Every degree of vascular obstruction was produced from slight venous obstruction alone to complete venous and arterial occlusion.

It was demonstrated that mild venous obstruction produces effects that differ little from those of non-strangulating obstruction. Severe venous obstruction, especially if associated with arterial obstruction, produces marked alteration in the motor function of the rest of the small intestine. "There is not only immediate spasm of the strangulated loop but also of the gut above and below it, which frequently affects the whole of the small intestine and even the pylorus, although the effect on the stomach is variable. After a time, which varies from a few minutes to several hours, the spasm lessens and intestinal movements recommence, . . . but in spite of prolonged vigorous contractions

Fig. 7. Strangulating obstruction of loop of ileum by adhesions to the cecum. Note absence of gas in proximal portion of small intestine. White arrows indicate loop of intestine which is largely fluid filled; black arrows show small amount of gas superiorly.

much distention does not take place until retrograde venous thrombosis has occurred or peritonitis is present."[2a]

Chesterman believes that retrograde venous thrombosis is the primary cause of marked intestinal distention, whether proximal or distal to an acutely strangulated loop of small intestine. If this process extends farther on the distal side, dilatation of the intestine is then found distal as well as proximal to the strangulation. These findings were confirmed not only by strangulating a loop of intestine but also by damaging the veins away from the strangulated loop, so that thrombosis took place with results similar to those described above. The intestine in these cases contains fluid and little if any gas.

Clinically it is precisely these cases which are the most dangerous and a careful routine of film analysis would indicate that even films showing few or no signs of mechanical obstruction should be scrutinized for signs of strangulating obstruction. This fact and its implications for roentgen diagnosis have been emphasized in earlier publications from this department[28] and by Frimann-Dahl.[14,16]

The inference to be drawn from these observations would seem to be that the venous return from a trapped loop of intestine may be impeded without a concomitant block of the intestinal lumen. Wangensteen[32] has stated that "transport (of gas and fluid) is possible through a strangulated loop of bowel which at operation may give every evidence of loss of viability." It is significant that in this series moderate amounts of gas were found in the colon in 9 cases and very small amounts in 8 additional cases (Fig. 9). This suggests either that the obstruction is not complete or that for some reason the evacuation of the distal segment of the intestine, which usually occurs with the onset of cramps in the simple obstructions, is less complete in strangulations.

While suction siphonage is not used if

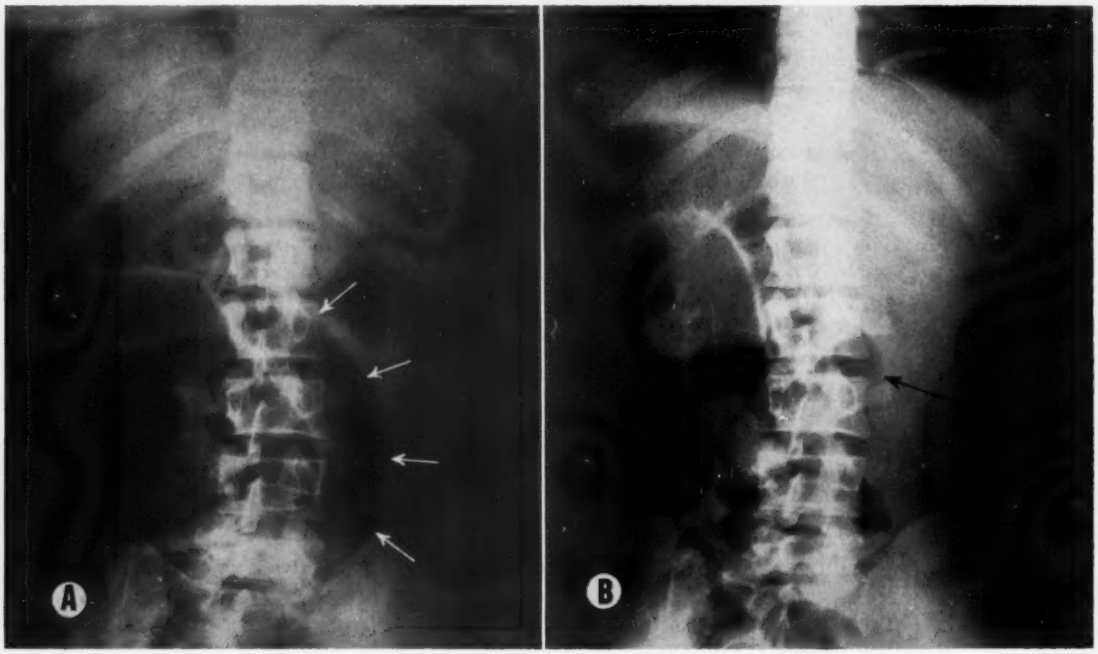

Fig. 8. (*A*) Supine film. Arrows indicate gas-distended loop in which mucous membrane markings are obliterated. (*B*) Erect film. Change in posture produces little change in the position of the distended loops, suggesting fixation. Operation revealed strangulation of 2.5 feet of ileum, 3 feet above the ileocecal valve, due to postappendectomy adhesions.

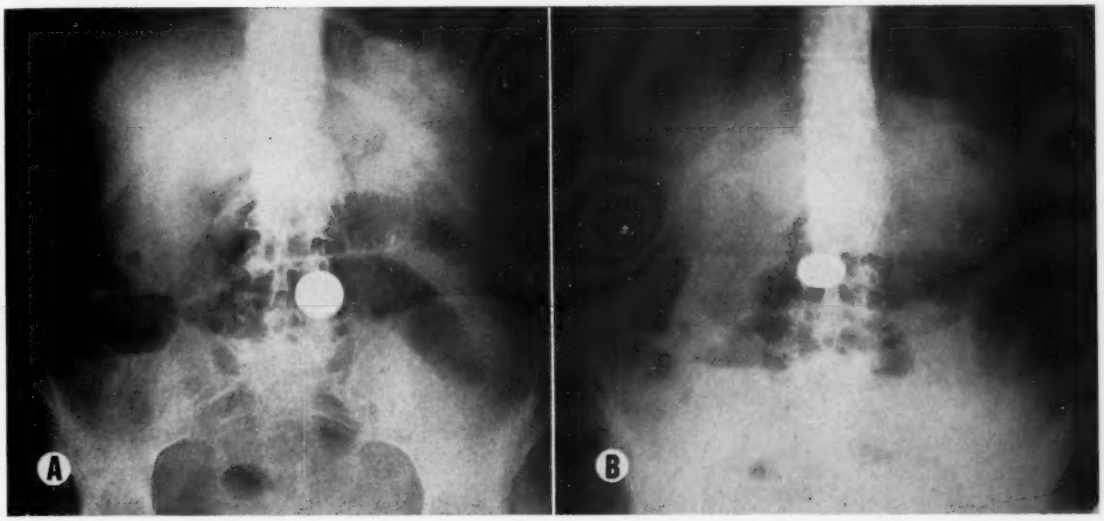

Fig. 9. Strangulating obstruction of segment of ileum 3 feet above the ileocecal valve. (*A*) Supine film. Note localized distention of ileac loops, absence of small intestinal gas proximally, and presence of small amounts of gas in the cecum. (*B*) Erect film. The gas-filled loops appear to be fixed in position.

there is any likelihood that strangulation obstruction is present, several cases have been seen in which continuous siphonage was instituted in patients thought to have simple obstructions, only to find that a single loop could not be decompressed. These cases have been operated upon promptly after this observation and closed loop obstructions have been found (Fig. 11). It should be emphasized that in cases where suction treatment is being used, the failure to evacuate one loop of intestine while all remaining loops are evacuated is strong evidence of a strangulating obstruction.

A group of signs of strangulation has been noted which are less frequent in occurrence and less specific in character. These are obstructing lesions showing long fluid levels (Fig. 12), large amounts of fluid

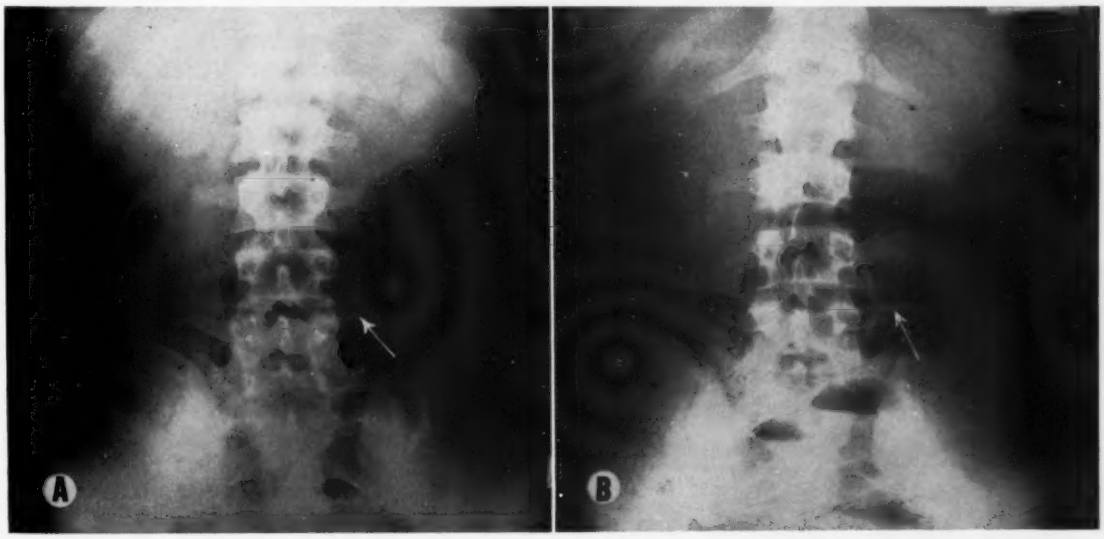

Fig. 10. (*A*) Supine film. (*B*) Erect film. Note very little change in the position of the gas-distended loops indicating fixation. Note also the paucity of gas in the proximal portion of the small intestine.

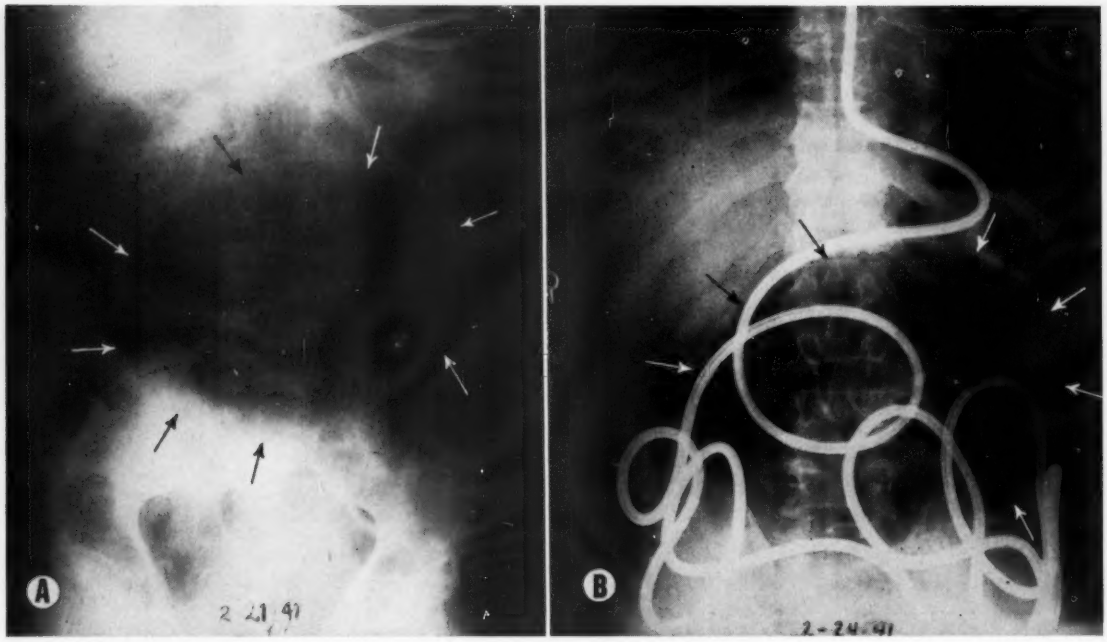

Fig. 11. (*A*) Supine film showing large "coffee bean" sign. (*B*) Roentgenogram after three days of suction siphonage reveals failure to decompress this segment. Exploration revealed a "closed loop" type of obstruction without strangulation.

in the loops (Fig. 7), or solitary segments of bowel distended out of proportion to the remainder of the intestine (Fig. 9). They suggest the possibility of strangulation and should initiate a search for the signs previously described as well as for clinical confirmation of the diagnosis.

Five cases of small intestinal volvulus were found in the series reported here. In none of them were there signs to suggest a twisted loop such as one sees in cecal or sigmoid volvulus, nor was there any evidence of loops radiating from a single point. There were no solitary gas-filled loops in an arcade pattern as described by Levine and Solis-Cohen[20] and Ripstein and Miller.[29] Two cases showed a positive "pseudotumor" sign, 3 showed fixation of loops and 2 revealed a segment of small intestine completely devoid of mucous membrane markings.

DIFFERENTIAL DIAGNOSIS

Strangulating obstructions may present findings which simulate or are simulated by the following conditions: normal abdomen, paralytic ileus, simple obstruction, peritonitis, inflammatory or strangulating tumors, mesenteric arterial and venous thrombosis, and neurovascular conditions.

Careful attention to solitary gas-distended loops or to fluid-filled loops which might otherwise be overlooked will permit the differentiation of an early strangulation from a normal abdomen. Although there is often some gas in the colon in strangulating obstructions, there is no colic or rectal distention, which would tend to rule out paralytic ileus. The differentiation from simple obstruction depends upon the presence of the signs previously detailed. Separations of these two conditions may be difficult if the patient is seen very early—for example, three to six hours after the onset of symptoms. Repeat examination in a few hours will probably indicate the proper diagnosis. Identification of other pelvic masses may offer some difficulty but the presence of a smoothly outlined, dense mass should speak, for example, for a twisted ovarian cyst rather than for a "pseudotumor" sign, as the latter is usually lobu-

Fig. 12. Volvulus of two-thirds of small intestine about adhesions from small intestine to anterior abdominal wall. "Arcade" sign is absent. Note long fluid levels.

lated in outline. Mesenteric arterial thrombosis may present the picture of bizarre distention of both the small and large intestine ending sharply at the splenic flexure. This would follow the distribution of the superior mesenteric artery. A barium enema will demonstrate that there is no organic obstruction at this level, suggesting the presence of the vascular lesion. A spastic ileus may give a somewhat similar picture.[24] Mesenteric venous thrombosis results in transudation into the bowel wall, the bowel lumen and the peritoneal cavity. This is of diffuse character as opposed to localized fluid-filled loops in a strangulation obstruction.[30] At most, a few small gas collections are seen. There may be a homogeneous density over the abdomen with poor definition of the soft tissue outlines within the abdomen.

SUMMARY AND CONCLUSIONS

The earlier diagnosis of strangulating obstructions represents one of the most effective ways of lowering the current mortality rate of small intestinal obstruction. Roentgenologic evidence of strangulating obstruction can assist very appreciably in the early diagnosis.

The roentgen signs are dependent upon the presence of a closed loop of intestine distended by either gas or fluid and giving evidence of a fixed position.

The roentgen findings, based upon an analysis of 26 cases, are detailed above.

The roentgen signs which are strongly suggestive and when present should lead to the diagnosis are:

1. The "coffee-bean" shadow.
2. The "pseudotumor" shadow.
3. Fixation of a loop of intestine.
4. Loss of the normal mucous membrane pattern within the closed loop or above it.

Additional signs of collateral value are:

5. Absence of small intestinal gas in a case suspected clinically of small intestinal obstruction.
6. The presence of unusually large amounts of fluid in the lumen of the small intestine.
7. Long fluid levels far beyond the usual size.
8. Distention of a segment of the intestine far out of proportion to the remaining loops.
9. Absence of decompression of a localized loop following suction siphonage.
10. The presence of moderate amounts of gas in the colon despite the apparent evidences of small intestinal obstruction.

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DISCUSSION

DR. JOSEPH C. BELL, Louisville, Kentucky. I know that we all feel very deeply indebted to Dr. Mellins and Dr. Rigler for the very practical and excellent presentation that we have just heard.

I am certain also that those doing gastrointestinal examinations, when confronted with the problem of the diagnosis of intestinal obstruction, have very often felt their inadequacy.

The theme of the presentation today, as I see it, is primarily that the mortality following intestinal obstruction is still much too high, that the mortality rate should be decreased, and to accomplish this it is necessary to distinguish more accurately and more promptly between simple and strangulated obstructions. The recovery rate from simple obstruction is reason-

ably good, but in strangulated obstruction it is far from satisfactory.

I like the definition of strangulated obstruction that Dr. Mellins gave, that of a block of the intestinal continuity and a compromise of the blood supply. There are varying degrees of block, in that they may be complete or incomplete, and gas may or may not be present in the involved portion of the bowel. There may be a high degree of compromise of the blood supply, or the compromise may be slight or entirely absent. These factors play a large part in the variability of signs that may be elicited.

The paper will justify very careful study, for there is important material in it not included in the oral presentation today.

It is emphasized that in all cases where strangulation is a consideration, upright, horizontal and lateral decubitus films are essential. Likewise, there is no single sign that must be present in order to make the diagnosis of strangulation.

The final point, one of great importance in improving accuracy of diagnosis, is that the possibility of strangulation must ever be kept in mind.

Dr. Ross Golden, New York, New York. There were two points made by Dr. Mellins which I think deserve emphasis. One concerns the obliteration of the mucosal folds. We know that simple gas distention of the jejunum will not obliterate the jejunal folds, no matter how great the distention is. It does not take much distention, however, to obliterate the folds in the ileum. Therefore, absence of folds in the ileum could not be taken as evidence of this sign. Furthermore, edema alone may widen the transverse folds of the jejunum sufficiently to flatten them out and make them difficult to see.

Dr. Mellins mentioned also the possibility that failure of deflation by the tube of the loops might be taken as suggestive of this; but we must remember that loops of small intestine which have been satisfactorily deflated may reinflate themselves under certain conditions; for example, in hypoproteinemia and hypopotassemia they may become re-distended.

Some years ago Dr. Leigh published a paper in which he pointed out three clinical signs suggestive of strangulation. One, and probably the most important, is continuous pain between the cramping attacks, which usually characterizes mechanical ileus; second, fever; third, a palpable mass.

Dr. Mellins and Dr. Rigler deserve our heartiest congratulations and thanks for this excellent study of an important subject.

Dr. Mellins (closing). I would like to thank Dr. Bell and Dr. Golden for their kind remarks and their discussion. We are in agreement with Dr. Golden about the difficulty of attaching much significance to the absence of ileal folds. We agree also that edema alone may widen the transverse folds and that large amounts of fluid may be present in the small intestine in many circumstances besides strangulating obstruction.

The latter was well illustrated by a recent experience at the University of Minnesota. One of the men on the staff of the Medical School was in another city, attending a meeting, and was suddenly stricken with abdominal pain. The surgeon and the radiologist who saw him felt that he might require surgery. He had fluid-filled distended loops of small intestine. He decided that if he required surgery he would go back to Minneapolis to have it.

He began to feel better as he got on the plane. As soon as he arrived in Minneapolis he felt much better, and he decided not to have the surgery after all. When the case was further investigated it was found that he was taking a mixture of codeine and papaverine for a cold, and that his reaction to the codeine produced so much fluid in the small intestinal loops that he had acute abdominal symptoms.

We are aware of many of the pitfalls in the roentgenologic diagnosis of strangulating obstructions and one must constantly think of all of them.

INTESTINAL ASCARIASIS IN MAN

By MAJOR D. W. MINTEER, M.C., FIRST LIEUTENANT J. D. HAYES, M.C., *and* LIEUTENANT COLONEL K. A. YOUNGSTROM, M.C.

From the U. S. Army Hospital

CAMP ATTERBURY, INDIANA

WE WISH to bring to the attention of all physicians the important part roentgen examination plays in the detection of *Ascaris* infestation, and to point out the particularly high incidence of this finding in Korean veterans.

This study includes 26 cases of ascariasis demonstrated by roentgen examination of the gastrointestinal tract. Of this number 23 had recently served in Korea. These cases represent approximately 5 per cent of the gastrointestinal roentgenologic studies done during this period. This experience is interesting when compared with that of Lofstrom and Koch[4] who found 6 cases of ascariasis in the course of 100 gastrointestinal roentgen studies in the Italian theater. Of our 26 cases of ascariasis diagnosed roentgenologically, stool examinations were done on 11, of which only 3 cases were positive. This leaves 8 cases diagnosed by roentgen ray on which a total of 20 stool examinations were performed, all of which were reported negative for *Ascaris* ova or parasites.

FIG. 1. A ninety minute study showing several *Ascaris* worms, some by subtraction defect only and others as both subtraction defect and with barium in the alimentary canal of the worm.

The roentgen diagnosis of ascariasis is not new. According to Buckstein,[2] *Ascaris* was first described in roentgen studies of the intestinal tract by Fritz in 1922, and clearly illustrated in his second contribution of 1924. There are many good illustrations of the typical roentgen finding in subsequent papers by many authors as well as those in the book by Buckstein. Only a few of our more significant films are therefore illustrated with this report (Fig. 1–6).

Human infestation from *Ascaris lumbricoides* is usually found where the individual has been exposed to poor hygienic conditions. The ova are swallowed and develop into larvae within the intestine. Here, they penetrate the intestinal walls and are carried to the lungs. They break through the wall of the alveoli, are swept up the trachea and reswallowed. The larvae develop into adult worms in the small intestine approximately sixty days after ingestion of the ova.[1]

The common complications are mechanical obstruction, intussusception and volvulus. Common areas of obstruction are at the ligament of Treitz and the ileocecal valve. Hypermotility of the intestine may exist secondary to local irritation by the worms. Actual perforation of the intestine has been reported. Stewart[6] and Ransom[5] have pointed out that, in addition to gastrointestinal complications, bronchopneumonia may occur secondary to the presence of larvae within the lungs. Belding[1] considers this the cause of Löffler's syndrome in a sensitized person.

The symptoms produced are many and depend primarily upon the organ involved. Our experience has been restricted to gas-

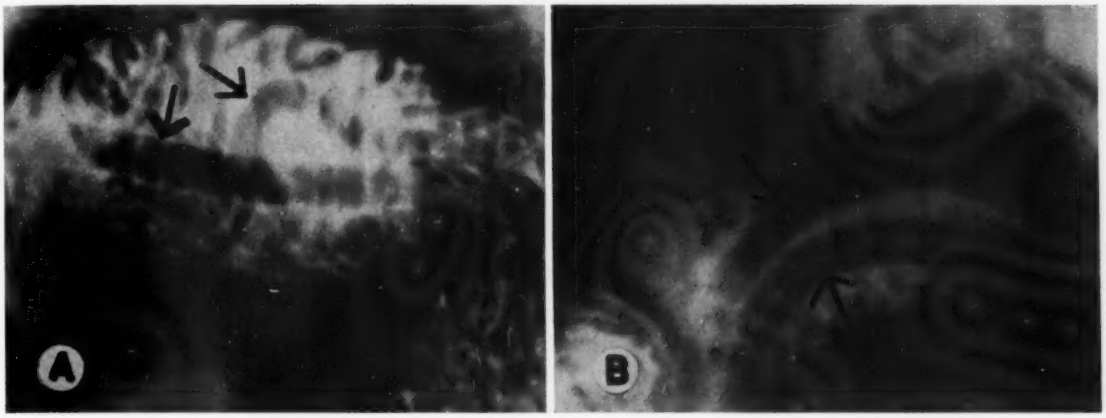

Fig. 2. Portion of a compression spot film showing the subtraction defect of *Ascaris* in detail (*A*); and another with barium in the alimentary canal of the worm as well (*B*).

trointestinal involvement. The common complaint has been a vague epigastric distress with some cramping in the lower abdomen. Nausea and vomiting have occasionally occurred with the abdominal pain. Other findings may be anemia, eosinophilia, fever, malnutrition, anorexia, headaches and urticaria.

The roentgenographic appearance of the worm itself is one of an elongated subtraction defect within the lumen of the intestine about the size of a lead pencil (Fig. 1, 2 and 3). The defect conforms to the position in the intestine. The diagnosis is very easily made on examination of the upper gastrointestinal tract using follow-up films taken after ingestion of U.S.P. barium sulfate, two parts to three of water. Some of the films show ingested barium within the alimentary tract of the worm (Fig. 1, 2*B*, 4 and 5), and again a typical appearance is presented. The alimentary tract of the worm may be well outlined after the column has passed beyond the worm (Fig. 4). The appearance at this time is a thin string, of barium density. In addition to observing the *Ascaris*, some segmentation

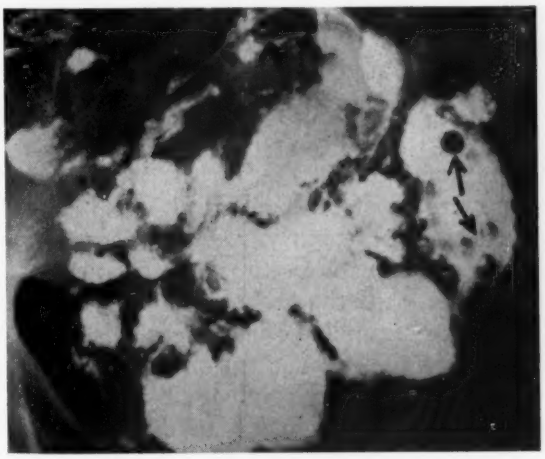

Fig. 3. The subtraction defects produced by the worm seen on end as well as side view in the ileum.

Fig. 4. The alimentary tract of the worm filled with barium after the barium meal passed beyond the worm.

FIG. 5. Barium in the alimentary tract of an *Ascaris* in the jejunum on the film taken at thirty minutes after the ingestion of barium.

of the barium column in the small intestine is occasionally observed. This finding is probably not significant. Krause and Crilly,[3] when reporting small intestine deficiency pattern changes in hookworm infestation, showed evidence of distortion of the mucosal pattern of the small intestine in a case of infestation by *Ascaris lumbricoides*.

FIG. 6. Typical filling defects of *Ascaris* in terminal ileum and in descending colon of a barium enema study.

The common areas where the worms are found are usually the distal jejunum and the proximal ileum; however, we have found some in the terminal ileum and, in the case described in Figure 6, one round worm was observed in the descending colon. Apparently this worm was in the process of being evacuated because the following day a fragmented worm was passed by the patient. The patient did not receive medication prior to this examination. Belding[1] states that the life of an *Ascaris* in the host is about one year.

Lofstrom and Koch[4] reported 6 cases in a 100 patient group in which the worms were not demonstrated in the twenty-four hour study after the barium meal. They used multiple hourly roentgenograms for the small intestine studies. Our experience indicated that the sixty and ninety minute films are usually of greatest diagnostic value for the demonstration of the typical subtraction defects produced by the worms. Three, four and five hour films are occasionally helpful, and need for these can be determined by observing the ninety

minute film wet for progression of the barium.

Several cases in which worms were demonstrated by roentgen ray failed to reveal any evidence of ova in the stool. One explanation offered is that the worms present were only of the male variety (3.3 per cent according to Yokogawa and Wakeshima cited by Belding[1]). We have observed such an example. A course of antihelminthic treatment resulted in the passage of a single male *Ascaris* worm. Subsequent roentgen study failed to demonstrate any ascarides. Another explanation is that the worms may be sexually immature at the time of the examination. This may well explain the absence of ova with positive roentgenographic findings. Several other cases have been re-examined after a course of medication and there remained evidence of ascarides within the bowel. Repeated courses of treatment have resulted in their disappearance.

SUMMARY AND CONCLUSIONS

1. *Ascaris* infestation of the intestinal tract has been observed frequently in Korean veterans.

2. The roentgenographic demonstration of round worms in the human intestinal tract is a valuable diagnostic procedure and seems to be more easily made than one would suspect.

3. Roentgenograms taken of the abdomen at thirty, sixty and ninety minutes after the ingestion of the barium meal seem to be the best procedure for finding most of the round worms in the small intestine.

4. This experience would seem to suggest that stool examination for ova is a less reliable method for detecting *Ascaris* infestation than is roentgen examination of the intestinal tract.

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METABOLIC CRANIOPATHY

REPORT OF TWO CASES ASSOCIATED WITH OSTEOPOIKILOSIS

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METABOLIC craniopathy is a clinical syndrome in which a metabolic dyscrasia, probably a dyspituitarism, causes a hyperostosis and various symptoms which could be attributable to the pituitary dysfunction and in part to pressure resulting from the hyperostosis frontalis interna.

Osteopoikilosis may occur in any of the bones of the body. There has been a studied aversion to ascribing symptoms to this condition.

The purpose of this paper is to report the first 2 cases of metabolic craniopathy associated with osteopoikilosis.

REPORT OF CASES

Case 1. Mrs. A.S., aged sixty-three, the mother of Case II, was admitted to Harper Hospital in June, 1950, complaining of pain in the right hip, radiating down the leg. In December, 1949, she had fallen and injured her back and right knee. Following this, she was troubled by backaches. Two days prior to admission, she suddenly experienced pain radiating from the back, down the right hip and posterior thigh to the toes. The pain was so severe and constant as to require narcotics. She was disabled and could not walk.

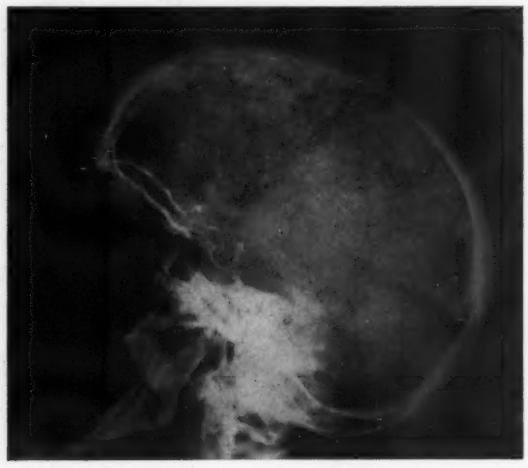

Fig. 1. Case 1. The roentgenogram shows hyperostosis frontalis interna and osteopoikilosis of the skull.

She has had ringing in the ears and deafness for thirty-eight years, following pregnancy. Headaches, severe and frequent, occurred for many years. These were greatly alleviated after a hysterectomy was performed in 1927 for severe bleeding. Dizzy spells have been present for a few years.

Physical examination revealed a short, obese individual with a postural hollow back. There was splinting of the lumbar spine in extension. The patient had arteriosclerotic changes in the retinal vessels. She was deaf, possibly as a result of otosclerosis during pregnancy. She had large acromegaloid features. Diminished knee and ankle jerks were elicited on the right side. Her blood pressure was 168/80.

Laboratory data were as follows: The calcium was 10.91 mg. per 100 cc. The phosphorus was 3.40 mg. per 100 cc. The alkaline phosphatase was 2.56 Bodansky units. The acid phosphatase was 3.75 units. Total proteins were 6.25 gm. per 100 cc. (3.65 gm. of albumin and 2.60 gm. of globulin) with an albumin/globulin ratio of 1.4:1. Glucose tolerance: fasting blood glucose was 109 mg. per 100 cc.; at $\frac{3}{4}$ hour it was 216 mg. per 100 cc.; at $1\frac{1}{2}$ hours it was 178 mg. per 100 cc.; at $2\frac{1}{2}$ hours it was 175 mg. per 100 cc. There was no sugar in any of the urine specimens.

The roentgenogram of the skull (Fig. 1) showed patchy zones of sclerosis throughout the skull in addition to thickening of the inner table. The roentgenograms (lateral and anteroposterior) of the spine (Fig. 2 and 3) showed patchy areas of sclerosis involving the vertebrae in the dorsal and lumbar spine, particularly. Local zones of sclerosis were seen in the vertebral bodies, and moderate sclerosis was seen at all posterior articulations.

The orthopedic opinion was that the symptoms were due to a lumbosacral strain syndrome with pain referred in type.

The question of Paget's disease of the skull and spine was resolved by the fact that in all

Fig. 2. Case 1. A lateral view of the lumbar vertebrae showing osteopoikilosis.

cases of active osteitis deformans the alkaline phosphatase is elevated. In this patient, although there was a lowered sugar tolerance, which is seen in osteitis deformans, the alkaline phosphatase was normal.

Case II. Mrs. E.M., aged forty-one daughter of Case 1. was admitted to Harper Hospital in December, 1951, complaining of an "anxiety neurosis." She had had no purpose in life for two years. Headaches, generalized and unremitting, had been plaguing her for six weeks. She had a similar depression and apprehension eleven years ago, lasting two years.

At twelve years, she wore a back brace for three years for curvature of the spine. She had a supracervical hysterectomy three years ago because of menorrhagia. Tinnitus of the left ear has been more or less constant for ten years. She has a chronic cough. Heartburn after tuna fish and fatty foods has been present for several years. She has two children. A miscarriage occurred eleven years ago. She has some weakness in the right leg and some right sacroiliac pain.

On physical examination, the blood pressure was 120/80. The nasal septum was deviated to the left. There was marked double scoliosis of her back. She was short and stubby, and had suggestive acromegaloid features.

Laboratory data: The red blood cell count was 5,130,000 per cubic millimeter, with a hemoglobin concentration of 13.8 gm. per 100 cc. The white blood cell count was 5,900 per cubic millimeter, with a normal differential count. The fasting blood sugar was 84 mg. per 100 cc. The nonprotein nitrogen was 34.7 mg. per 100 cc. Total proteins were 6.90 gm. per 100 cc. (4.81 gm. of albumin and 2.09 gm. of globulin), with an albumin/globulin ratio of 2.3:1. The alkaline phosphatase was 6.6 Bodansky units and the acid phosphatase was 3.53 units. The calcium was 11.4 mg. per 100 cc., and the phosphorus was 3.2 mg. per 100 cc. Total cholesterol was 402 mg. per 100 cc., cholesterol esters being 240 mg. per 100 cc., or 59.7 per cent of the total. The basal metabolic rate was minus 11. The electrocardiogram was normal.

Film study of the skull showed thick flat bones of the cranial vault with prominent vascular markings. There was an increase in thickness chiefly on the inner table of the frontal bone as one expects in hyperostosis frontalis interna (Fig. 4). There were no signs of increased

Fig. 3. Case 1. An anteroposterior roentgenogram of the dorsal vertebrae showing osteopoikilosis.

FIG. 4. Case II. A roentgenogram showing hyperostosis frontalis interna.

intracranial pressure. The pituitary fossa was deep but was not evaluated as definitely abnormal.

Cholecystogram showed normal function of the gallbladder, but the gallbladder did contain several semi-opaque gallstones.

Examination of the complete spine and pelvis revealed the presence of multiple areas of increased density of varying size with ill-defined borders throughout the entire spine and in the sacrum and both iliums (Fig. 5 and 6).

FIG. 5. Case II. A roentgenogram showing osteopoikilosis of the dorsal vertebrae.

In January, 1952, an electroencephalogram was normal. Glucose tolerance: fasting blood glucose was 104 mg. per 100 cc., at ¾ hour it was 178 mg. per 100 cc., at 1½ hours it was 135 mg. per 100 cc., at 2½ hours the blood was clotted; at 5 hours it was 90 mg. per 100 cc. The fasting urine glucose was negative. The urine was positive for glucose at ¾ hour and again at 1½ hours. At 2½ hours and at 5 hours, the urines were negative for glucose.

FIG. 6. Case II. This roentgenogram shows osteopoikilosis of the lumbar vertebrae, the sacrum, and both iliums

The lesions of increased density found in the vertebrae, the sacrum, and both iliums could have been misinterpreted as osteoblastic metastases or an atypical form of Paget's disease. However, clinical consideration led to a diagnosis of osteopoikilosis. The complete diagnosis for this patient was: (1) metabolic craniopathy associated with osteopoikilosis, (2) marked double scoliosis of the back, and (3) cholelithiasis.

DISCUSSION

Metabolic craniopathy as a clinical syndrome is still being disputed reports Dann[3]

in an excellent review of the subject. Nevertheless, a definite symptomatology has become associated with hyperostosis frontalis interna or metabolic craniopathy as enumerated by Moore:[13] headaches, frequently referred to the forehead with occasional tenderness of the skull and a feeling of pressure; obesity; muscular weakness and fatigue; nervousness; confusion; worry and depression are common; memory defects; dimness of vision and occasional diplopia; epileptiform seizures; mental slowness and dementia; dizziness; disturbance in equilibrium and gait; tinnitus; involvement of the fifth and seventh nerves; occasional speech defect; loss of smell; dragging or weakness of an extremity; general neuromuscular insufficiency; overgrowth of hair on the chin and less frequently on the upper lip in females. Carr[2] adds menstrual disturbances, such as profuse, painful menstruation and frequent clots. Others add hypertension, and diabetes mellitus and insipidus. Carr emphasized considerable fluctuation of symptoms, but noted that headache, weakness, dizziness, and defective memory tended to remain constant. A definite sex relationship exists, from 88 to 98 per cent of cases occurring in females.

Knies and Le Fever[9] point out the "truly constitutional nature of this disease in which the bony changes can be considered only a pathognomonic part and a sine qua non to the diagnosis." They imply that the bony lesions may antedate the symptomatology and, conversely, the symptoms may antedate and develop independently of the bony lesions.

They credit the first description to Morgagni and Santorini in 1765. Stewart in 1913 performed the first autopsy, and Morel in 1930 described the first living case. To Stewart, Carr and Henschen they give credit for adequate cataloging of its clinical features, sufficiently delineated and characteristic to suggest that roentgenographic findings may not be essential to the diagnosis.

Knies and Le Fever state further that acromegaloid characteristics and true acromegaly have been noted. They feel that the pituitary involvement has apparently been associated with insufficiency, at times after a preliminary period of hyperfunction as attested by the acromegaloid changes.

According to M. T. Moore,[12] if endocrine manifestations and craniopathy predominate and there is no overt psychosis or psychoneurosis, it is called Morgagni's syndrome; if neuropsychiatric disorders develop, the term Stewart-Morel syndrome may be applied.

A familial history is present in a number of case reports. Some authors believe that hyperostosis frontalis interna is inherited as a dominant trait. Henschen[5] suggested a possible hereditary influence in determining the frontal location of the bony changes by a modification of the appropriate gene; a possible sex-linked hereditary factor, perhaps operating by pituitary determination. He[6] labels hyperostosis frontalis interna the "fifth pituitary syndrome."

Most of the recent writers have implicated the pituitary gland and the hypothalamus in the pathogenesis of the syndrome, producing both the bone changes as well as the other symptoms. Lichtwitz[11] states that the hypothalamus is essential for emotional expression which is normally restrained by cortical control; in hypothalamic disorders, when cortical control is weakened, emotional instability and abnormal behavior come to the fore.

Others[3] believe that pressure of the increased intracranial bone creates symptoms.

Mortimer and associates[15,16,17] found the whole calvaria thickened particularly in the frontal bone, the inner table of which is thicker and denser than normal, a sclerosing process apparently having extended from the inner table into the adjacent middle table. The whole face is well pneumatized.

They felt that during adolescence the patient had a transitory hyperpituitarism which manifested itself in general body conformation as well as in cranial proportions and structure, suggestive of acromegaly with psychosis.

They hypothecate that the psychiatric

condition might owe its fundamental etiology, perhaps in part, to abnormal functioning of those factors which regulate and control growth and development in the widest sense.

They found no abnormality of the sella turcica.

Hypophysectomized animals were treated with somatotropic hormones. The normal architectural structure of the cranium was restored by a specific effect on the vascularity. Crude alkaline growth extract caused sclerosis as resistance developed, especially as the animal became resistant to the ketogenic effect of hormones, and this sclerosis was associated with obesity.

Their Types 2 and 4 of cranial dysplasias of pituitary origins, characterized by sclerosis, are ten times more frequent in the female than in the male. Result is thickening of the calvaria. Experimentally they produced similar calvarial sclerosis by such treatment as renders a hypophysectomized rat resistant to the ketogenic effect of certain anterior lobe extracts.

It is failure in this direction, occurring spontaneously, which is an etiologic factor in the production of these dysplasias.

Of 494 cases of cranial dysplasia, 18.3 per cent showing dyspituitarism and dysplastic crania gave evidence not only of general bodily disturbance of growth and development but also showed significant personality changes.

Sherwood Moore[13] describes the pathology as follows: The hyperostosis involves the frontal bone, which has on its inner table deposits of new bone with occasional extensions to other bones in the base of the skull. This overgrowth of cancellous bone lies on the inner table and is covered on its intracranial aspect by smooth lamella of compact bone. The deposit of bone is increased in density as seen in the roentgenograms. The osseous change is confined to the skull, and no evidence has been found that the remainder of the skeleton is involved, although a systematic search has not been made.

Knies and Le Fever[9] report that changes in hyperostosis have rarely been described. Osteoclastic activity has been described in excess of osteoblastic changes, especially in the frontal bones. There is a noninflammatory deposit of new bone on the internal table of the squama frontalis, occasionally extending to the orbital plate, the falx, and the squama parietalis. Hyperostoses are usually symmetrical and there is an associated increase in the bone thickness of the internal table and diploe, while the external plate is spared.

The terms hyperostosis calvariae diffusa and frontoparietalis were suggested by Moore[14] to indicate involvement of the entire vault.

From a roentgen point of view, Young[25] finds that benign hyperostosis of the inner table of the skull occurs principally in the frontal bones, where it usually presents a scalloped appearance. The excess bone arises from the inner table on both sides of the midline. The overgrowths are seen in approximately 5 per cent of all skulls and occur predominantly in women with clinical changes that suggest endocrine and metabolic disturbances.

The basal metabolic rate, calcium, phosphorus, and phosphatase levels have been normal. Increased blood cholesterol and creatinuria may occur. Decreased glucose tolerance and insulin resistant diabetes have been reported.[3,9,12]

Metabolic craniopathy must be differentiated[3] from (1) Paget's disease and Dercum's disease; (2) diabetes mellitus and insipidus; (3) hysteria; (4) brain tumor; (5) psychoneurosis; (6) Menière's syndrome; (7) multiple sclerosis; (8) Cushing's syndrome; (9) incipient paresis; (10) pellagra and beri-beri; (11) neurosis; (12) psychosis; (13) Alzheimer's or Pick's disease; (14) cerebral arteriosclerosis.

Remarkable improvement and variability may at times occur, but this syndrome is the cause of serious morbidity and loss of productivity in those unfortunate individuals afflicted with it. Knies and Le Fever state that the average case has as its future the status quo, or gradual progression.

Carr[2] pointed out the efficacy of treatment with amino-acetic acid by large feedings of gelatin daily.*

Osteopoikilosis or osteopathia condensans disseminata is characterized by disseminated condensations of the bones of the skeleton without clinical symptoms.[22] Wilcox,[22] in 1932, in an excellent review states that all of the bones, except the skull, have been shown to be involved. Multiple areas of increased density from 2 mm. to 2 cm. in diameter are found in the spongiosa of the epiphyses of bones. The condition is observed in both sexes and as it is symptomless is found by accident during roentgen examination for some other condition.

Albers-Schönberg[1] in 1915 reported a case, calling it a rare structural anomaly of the skeleton. In 1916, Ledoux-Lebard, Chabaneix and Dessane[10] reported a case and called it "ostéopoecilie" because of the spotted appearance of the bones.

The etiology is unknown. It is evident that there are more or less uniform disturbances in the proliferation and the ossification of bone-forming cartilage during the period of development.

Voorhoeve[21] reported 2 cases in 1924 and stated that he believed the anomaly to be hereditary.

Schmorl[19] in 1931 made a careful necropsy study of an eighteen year old boy who had osteopoikilosis, but died from secondary anemia and amyloidosis complicating osteomyelitis. He found an increased density, the result of numerous bone trabeculae of various thicknesses arranged rather regularly, the bone resembling the structure of spongiosa and not cortex. Individual trabeculae were slightly thicker than normal bone and gave the impression of a compact bone. Merging into the surrounding structures was gradual, trabeculae disappearing among those of normal spongiosa. The thicker trabeculae consisted of lamellous bone with a parallel arrangement, for the most part, but in a few instances it was also arranged concentrically around blood vessels without, however, leading to the picture of osteoma.

The most plausible theory[19] is that of a congenital anlage. The spots within the osteoporotic ankylosed areas themselves showed signs of osteoporosis.

Wilcox comments on the hereditary nature of its etiology, and presents 2 cases, of father and son. The disturbances observed were so uniform that the hereditary character of the lesion at once became apparent.

One sister had an unusual deformity of the right side of her head which had been present since childhood. There was prominence of the right frontal area of the skull with drooping of the right eyelid. Bony structures were all negative on roentgen examination except the skull; "a marked hypertrophy of the inner and outer tables of the skull, which are completely fused. The process involves the skull on the right side from near the vertex posteriorly to the level of the supra-orbital plates and the hypertrophy extends down into the sphenoidal sinus region. . . . It has somewhat the characteristics of leontiasis ossia."

The bone changes in the sister were shown only as a matter of interest, the exact nature and etiology being unknown.

In 1933, Wilcox[23] gave a résumé of 23 cases reported to date. He described the lesions as being grossly spherical oval or oblong. He also described a striated form, and a combination of the two.

Nichols and Shiflett[18] state that Svab reported the condition in 2 sons and a father with a familial history of diabetes.

They also reported Schmorl's case in detail.

Nichols followed a patient for seventeen years. Her symptoms led to a diagnosis of hypopituitarism and osteomata and numerous deposits in bone (1916), and later of hypopituitarism, hypothyroidism and osteopoikilosis.

The onset was in early adolescence and continued into adult life. Roentgenograms

* Case 11 has been taking two packages of Jell-O and 60 grains of ammonium chloride daily since January. Oreton M, 10 mg. daily, was taken for thirty days, followed by 10 mg. every other day for another thirty days, then 10 mg. twice a week. All her symptoms, except the tinnitus, have been greatly ameliorated since April.

showed multiple osteochondromata with one lesion like a cyst; multiple disseminated osteopoikilosis; and apparently a definite and marked proliferative periostitis of the long bones.

The patient, now thirty-five, was first observed at the age of eighteen because of headaches and pains in the feet and legs. All members of the family were overweight. She had frequent earaches as a child. Considerable headaches had occurred since thirteen years of age. She experienced occasional burning on urination. She was never considered very bright. Menarche occurred at seventeen years. The periods were irregular and accompanied by severe fatigue and followed by nervousness and weakness, also hot flashes and dysmenorrhea. She complained of pains in her feet and legs at the age of thirteen. She had severe generalized headaches and burning sensation in her eyes. There were pains in her chest and side. She had nervous insomnia. She had frequently been told there was nothing wrong with her.

Physical examination revealed marked tenderness over the entire skull. She was sensitive over the entire chest and abdomen.

She was again seen in 1926. Her weight at twenty-eight years was 142 pounds. Almost continuous frontal headaches were present. She had frequent colds. Her appetite was fair. She had marked constipation. Menses became normal at twenty-one.

Physical examination showed fat pads over her hips and back and huge breasts.

Glucose tolerance showed a prediabetic curve: fasting blood glucose was 73 mg. per 100 cc., at ½ hour, after 100 gm. of sugar, the blood glucose was 200 mg. per 100 cc., at 1 hour it was 196 mg. per 100 cc., at 2 hours it was 159 mg. per 100 cc., at 3 hours it was 116 mg. per 100 cc., at 4 hours it was 71 mg. per 100 cc. Sugar was present in the urine in the 1 hour and 2 hour specimens.

She continued to complain of body pains, constipation, frequency and burning on urination, swelling of hands, headaches, nervousness, insomnia, and soreness over joints. There was frequent relief of one or more symptoms with recurrence of others.

In 1934, Erbsen[4] presented a case of osteopoikilosis of the cranium and pelvic bones. This appears to be the only case of osteopoikilosis of the cranium on record.

Several authors mention the presence of dermatofibrosis lenticularis disseminata and feel there is an associated constitutional basis for both conditions.

Holly[8] presents 4 cases—a mother, 2 sons, and a daughter. The mother, one son and the daughter were followed for five years. He found evidence of definite changes in the islands of condensation. Some entirely disappeared, others enlarged, and new areas also appeared.

He describes Case 1: W. F., aged thirty-two, cough, occasional pain in chest, sputum, short of breath on exertion. Pains in joints of the left hand and wrist. Occasional headaches between the eyes, inability to breathe well through the nose and some deafness in the right ear for two years.

Hinson[7] in 1939 stated that Stiede[20] in 1905 first described the disease. He believed that 72 cases had been reported to date. He felt that the condition must be differentiated from carcinoma, sarcoma, syphilis, osteomyelitis, tuberculosis, typhoid, and melorheostosis of Léri.

He quotes two necropsies, one by Schmorl and the other by Windholz.[24] The latter observed absence of osteoblasts. Osteoclasts were present.

It is interesting that most writers on osteopoikilosis state that there are no symptoms. Nevertheless, various symptoms have been described in several cases, which are not unlike those of metabolic craniopathy, as, for example, Nichols and Shiflett's case.

It appears plausible that both bone processes could be related through a pituitary mechanism, although they may co-exist as independent conditions.

The 2 cases here presented in a mother and her daughter would bear out a sex-linked hereditary nature of hyperostosis frontalis interna. Moreover, the granddaughter, aged sixteen, although not showing hyperostosis frontalis interna or osteopoikilosis roentgenologically, has had an operation for squint, has emotional upsets, and has not yet menstruated.*

SUMMARY AND CONCLUSIONS

Two cases of metabolic craniopathy (hyperostosis frontalis interna) with concomi-

* The granddaughter, upon examination, was observed to have a congenitally absent uterus and vagina.

tant osteopoikilosis in a mother and daughter have been presented.

There is strong evidence presented for the hereditary nature of osteopoikilosis and the sex-linked hereditary nature of metabolic craniopathy, the latter probably being inherited as a dominant trait.

A metabolic disturbance associated with pituitary dysfunction is apparently responsible for hyperostosis frontalis interna. The symptoms are those of the varying functions of the pituitary which may be affected.

Although the most plausible theory for osteopoikilosis is that of a congenital anlage, it is possible that it, too, may be due to a pituitary dysfunction.

The history, etiology, pathology and symptomatology of both conditions have been discussed.

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BASILAR ARTERY ANEURYSM

REPORT OF A CASE DIAGNOSED ROENTGENOLOGICALLY*

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ANEURYSMS of the basilar artery occasionally attain such size as to produce symptoms of a tumor mass. The roentgenologic studies of the present case permitted the establishment of the clinical diagnosis with reasonable certainty.

CASE REPORT

The patient, C. B., male, Italian, aged fifty-nine, entered the Wadsworth Hospital, Veterans Administration Center, in June, 1952, complaining of general weakness and frequent episodes of falling occurring over the past months.

The pertinent items in his history included the following data: Eleven years previous to admission this physically active and healthy man suddenly felt nauseated and light headed. He collapsed on his bed, experienced a flash of red light, and lost consciousness. A period of amnesia, which lasted several hours, followed. He experienced immediate difficulty in talking, swallowing, and breathing. He was unable to move his right upper and lower limbs, but he was unaware of pain, headache, or stiffness in the neck. He was quite alert and noticed no further visual troubles. He was able to take food within three weeks, and eight weeks after his illness he was able to bear his own weight when walking.

No notable change in his condition occurred from 1942 to 1951. In 1951, however, strength in his limbs slowly began to deteriorate on both sides. He fell on numerous occasions and lost some of his previously regained facility for talking and swallowing. An episode of pneumonitis led to his admission to the hospital.

His father had died of a "stroke" at the age of sixty-nine. His mother was suffering with a "stroke" at the age of eighty-one. His only sibling had died at age fifty-five of "heart trouble."

General examination at the time of admission in June, 1952, disclosed signs of bilateral pneumonitis. These signs disappeared under therapy.

In August, 1952, he was seen as an emotionally labile, stocky, fifty-nine year old man who sat in a wheel chair. His blood pressure was 140/90. General examination revealed only the presence of bilateral pitting ankle edema. Mentally he was alert, oriented, and gave a lucid history.

His head was of normal contour with no bruit. The retinal arterioles possessed heightened light reflexes. There was no evidence of papilledema. The left palpebral fissure was wider than the right. Upon expression of emotion, the right side of the face was more active than the left, and during voluntary movement the left half reacted more vigorously. He was unable to whistle. A slight degree of loss for hearing higher tones was present in both ears.

Speech was hoarse, gurgling, wet, and dysarthric, but of normal content. Swallowing was slow and incomplete. The uvula of the soft palate deviated to the right and the gag reflex was impaired bilaterally. Pharyngeal sensation on the right was impaired. The vocal cords appeared flabby and neither adducted through full range.

Motor examination revealed a severe right hemiplegia which obscured a mild left sided weakness. Resistance to passive muscle stretch with a clasp-knife pattern was present in the flexors of the right upper limb and extensors of the lower limb on the right. The patient could approximate the thumb and index finger voluntarily and slight finger flexion occurred together with toe plantar flexion and knee extension. No antigravity movements could be performed. The upper and lower limbs were about equal in their degree of weakness. The reflexes were increased in the right limbs. Bilateral abnormal plantar responses were present. Sensation was normal.

Electroencephalogram and electrocardiogram were normal. Spinal fluid examination disclosed a normal pressure, two lymphocytes per cu. mm, 82 mg. per cent of protein, and a negative Wassermann reaction. Blood and urinalyses performed subsequent to his pneumonitis were normal.

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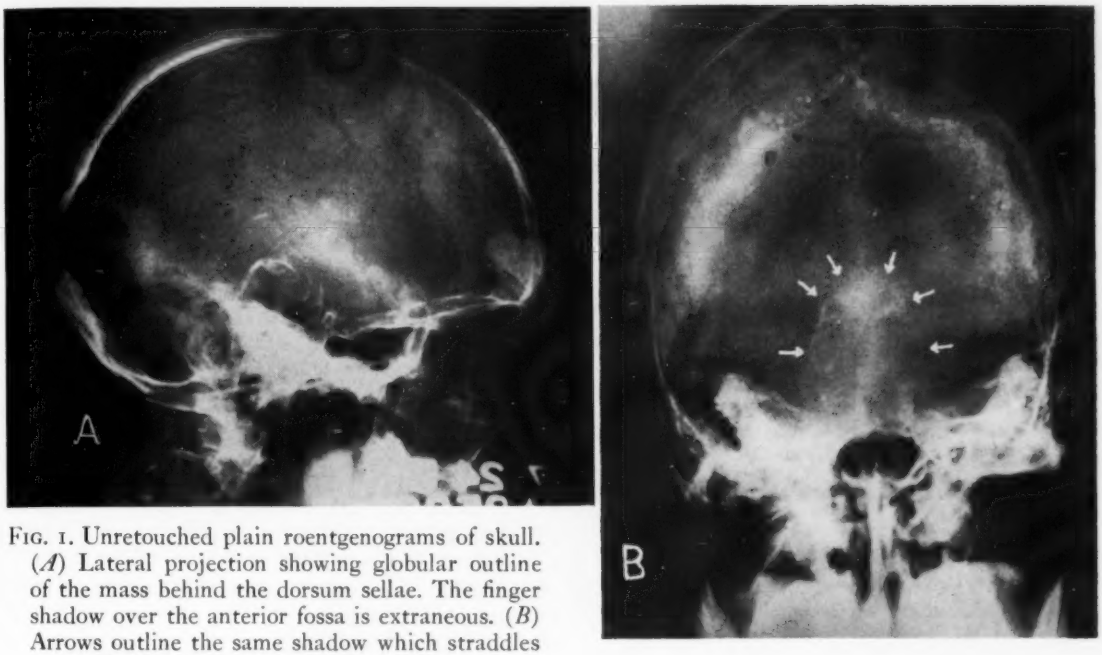

Fig. 1. Unretouched plain roentgenograms of skull. (*A*) Lateral projection showing globular outline of the mass behind the dorsum sellae. The finger shadow over the anterior fossa is extraneous. (*B*) Arrows outline the same shadow which straddles the midline of the half axial projection.

Plain roentgenograms of the skull were remarkable (Fig. 1). An oval shadow suggesting the calcified outline of a mass lay behind the dorsum sellae and clivus. In the lateral view, this area measured 3.3 cm. in depth and 3.3 cm. in height. In the half axial view, the width was 4.0 cm. and the height (or length) 5.5 cm. Laminagrams confirmed the apparent globoid structure of the mass with its maximum radiodensity lying in the "wall" or periphery (Fig. 2). This dense "wall" varied in thickness throughout the mass. The density of radiopacity decreased within the core of the lesion. The outlines of "calcification" were sharply curved or curvilinear but not everywhere continuous.

There was no evidence of bone erosion. The mass, therefore, lay in a space normally filled by the prepontine and interpeduncular cisterns, the pons itself, and a portion of the fourth ventricle and midbrain. The posterior margin of the shadow lay within the area normally occupied by the fourth ventricle.

The clinical diagnoses which were entertained included calcified basilar artery aneurysm, neoplastic cystic tumor (craniopharyngeal cyst), and calcification in normally located arteries—including the choroid plexus—with thromboses on an arteriosclerotic basis.

Vertebral and common carotid angiography performed on the right side gave reasonable confirmation to the first mentioned diagnosis (see Fig. 3). Thirty-five per cent Diodrast filled the posterior fossa vessels and both posterior cerebral arteries. The shadow of the Diodrast lay "within" the calcified mass suggesting that the latter incorporated a displaced basilar artery. While anteroposterior views were not technically possible, it appeared significant in the lateral projection that the posterior outline of the opaque medium superimposed exactly

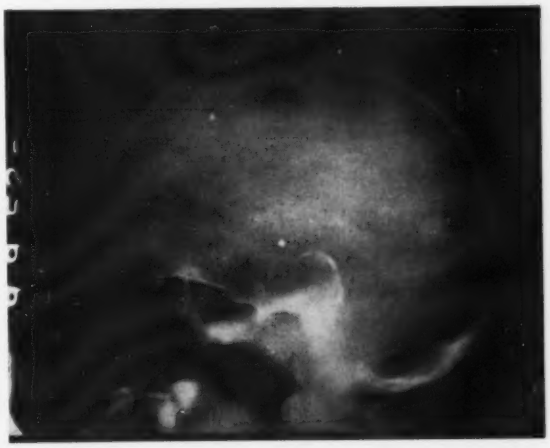

Fig. 2. Unretouched laminagram showing the heavy distribution of the opaque material in the periphery of the globular "aneurysm."

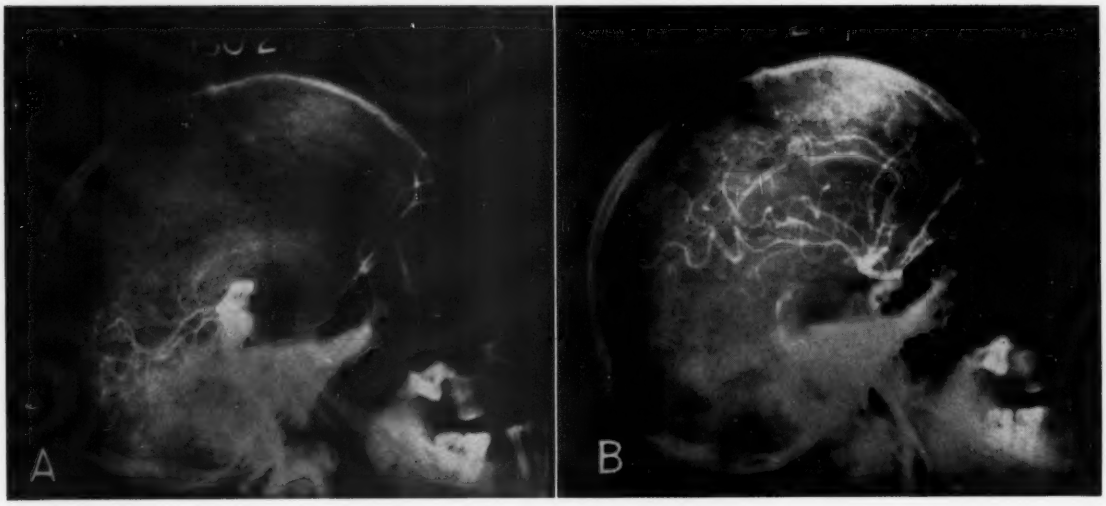

FIG. 3. Unretouched angiograms performed with the use of 35 per cent Diodrast. (*A*) Vertebral angiogram. Note the posterior displacement of the basilar artery from its relation to the clivus. Note the saccular bulge in the proximal segment of the vessel in its distal one third and its scalloped aspect. (*B*) Carotid angiogram. Note the relationship of the middle cerebral complex to the "calcified" mass and the lack of demonstrable communication between the two halves of the circle of Willis.

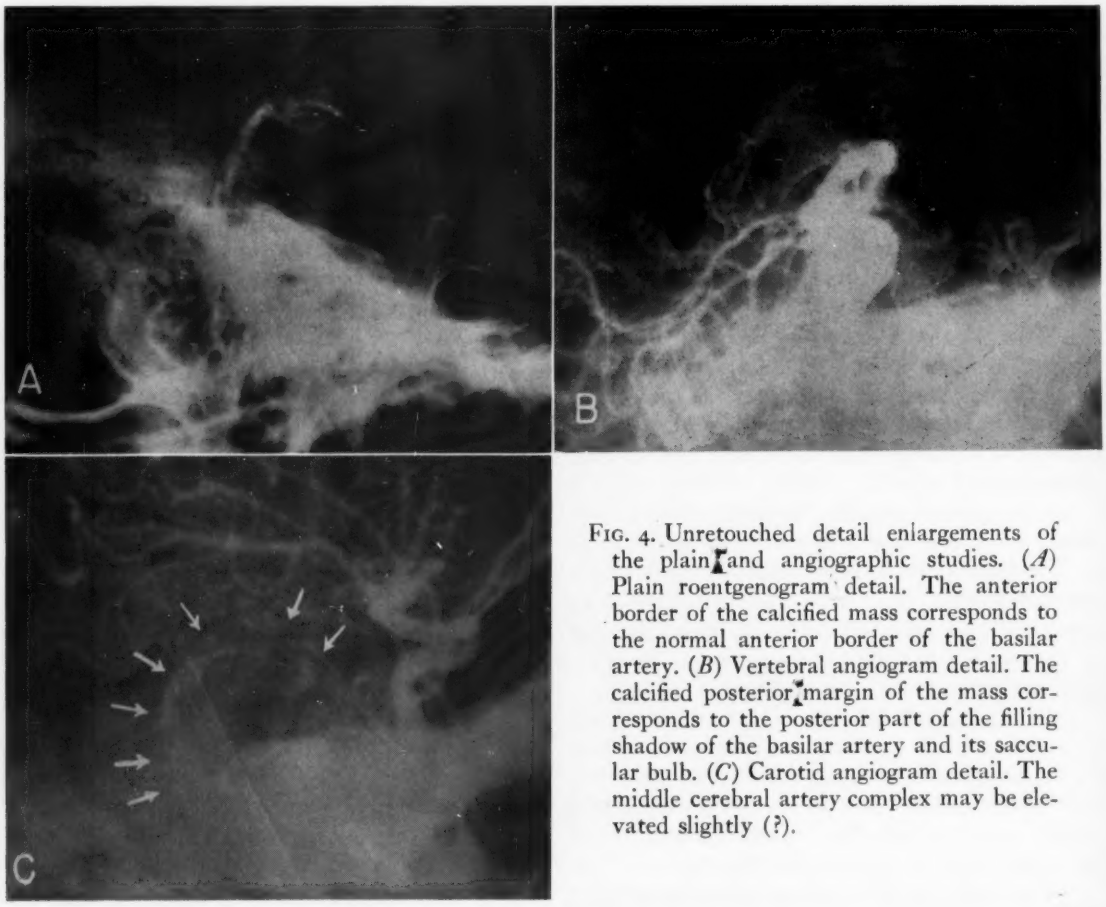

FIG. 4. Unretouched detail enlargements of the plain and angiographic studies. (*A*) Plain roentgenogram detail. The anterior border of the calcified mass corresponds to the normal anterior border of the basilar artery. (*B*) Vertebral angiogram detail. The calcified posterior margin of the mass corresponds to the posterior part of the filling shadow of the basilar artery and its saccular bulb. (*C*) Carotid angiogram detail. The middle cerebral artery complex may be elevated slightly (?).

upon the contour of the "calcification." Thus the measurement from the dorsum sellae to the posterior rim of each was 3.4 cm. No communication between the anterior and posterior circulation of the circle of Willis was visualized and the supratentorial vessel patterns were normal (Fig. 4). The distance between the internal carotid artery and the origin of the posterior cerebral arteries was abnormally great and presumably was bridged by stretched posterior communicating vessels and/or an aneurysmal sac with obliteration of the normal communication between anterior and posterior circulation. This distance measured 2.5 cm. as illustrated by the accompanying tracing of the superimposed angiograms (Fig. 5). The normal distance should approximate 1.5 cm.

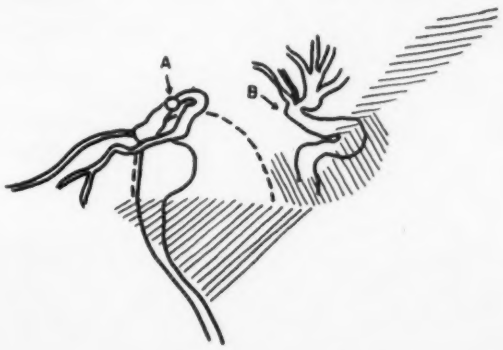

Fig. 5. Tracing prepared from the superimposed vertebral and carotid arteriograms to demonstrate the abnormal distance between the origin of the posterior cerebral arteries "A" and the carotid sigmoid "B" at the probable site of origin of the posterior communicating artery. This distance measures 2.5 cm.

The patient has shown no further progression of his symptoms in the three months since August, 1952.

DISCUSSION

The roentgenologic appearance of basilar artery aneurysms has not received close attention primarily because of the relative infrequency of such lesions and the fact that apparently only a minority is associated with any specific roentgenographic change. In spite of the frequent use of angiography, our information on basilar artery lesions is scanty.

Large tumor-like aneurysms (not arteriovenous malformations) of the basilar-vertebral complex have been well described since the illustration of Cruveilhier (1835) and the report of Lebert (1836). McDonald and Korb (1939) reported 143 basilar and 59 vertebral aneurysms among a total of 1,023 intracranial aneurysms. These lesions made up approximately 20 per cent of the total. The lesions were of all sizes. Richardson and Hyland (1941) encountered 8 examples of large unruptured intracranial aneurysm, 3 of which arose from the basilar-vertebral artery complex. The largest aneurysm in the University of Toronto series occurred at the junction of the right vertebral and basilar arteries and measured 5 by 3 by 2 cm.

According to the excellent review of Yaskin and Alpers (1944), large vertebral artery aneurysms are due in the majority of cases to arteriosclerosis and occur between the ages of forty and sixty years. In this age group (41–86 years) McDonald and Korb (1939) found 293 cases of intracranial aneurysm in all locations and reported that 75 per cent of these were due to arteriosclerosis. Rigdon and Allen (1944) do not concur with the opinion that such a high proportion of these lesions are due to arteriosclerosis. These authors reviewed the 70 cases of vertebral artery aneurysm reported in the literature, presented detailed studies of 2 more, and concluded that such lesions more frequently have origin in congenital defects that appear in the arterial wall and that such defects must be considered even among those patients with arteriosclerosis or syphilis. The latter disease may be responsible for a small percentage of these aneurysms [Boinet (1910) and Bassoe (1939)], and Lindsay (1944) reported an isolated example of posterior fossa aneurysm due to rheumatic arterial disease.

The aneurysmal mass will frequently consist of a thin wall of connective tissue without elastic membrane or smooth muscle in which may be located patches of calcification. The lesion may be wholly or in part filled with firm thrombus (Richardson and Hyland, 1941).

The clinical history is one either of sudden death from rupture in a patient previously free of suggestive symptoms or of the development of signs and symptoms of a posterior fossa space-taking mass which may terminate from medullary compression or rupture. Thus Yaskin and Alpers (1944) reviewed 35 clinical histories of vertebral artery aneurysm and found 16 cases of rupture with death and 21 cases of large unruptured lesions with symptoms for many months or years. The rare combination of repeated subarachnoid hemorrhage plus focal signs of posterior fossa compression may permit an accurate clinical diagnosis (Krayenbühl, 1941).

Alajouanine, Le Beau and Houdart (1948) emphasized the clinical picture caused by such large unruptured lesions. They may compress the medulla and pons. They may involve isolated cranial nerves or combinations of the lower cranial nerves. They may present either in the midline or unilaterally. In the latter case, they can simulate a cerebellopontile angle tumor, produce hemifacial spasm, facial pain, or a Ménière-like syndrome—a variety of pictures each of which depends not upon the nature of the mass but upon its location. The aneurysm may, of course, be responsible for thromboses of important paramedian and circumferential arteries which arise from the basilar-vertebral complex. According to the last mentioned authors, the commonest clinical picture includes:

1. Symptoms of headache, nausea, and vomiting, and the syndrome of increased intracranial pressure;
2. Strongly unilateral pyramidal tract involvement without sensory impairment;
3. Paralysis of the caudal group of cranial nerves; and
4. Disturbances of equilibrium.

Such a picture, although it may develop chronically, gives little clue as to the nature of the tumor mass.

Roentgenologic Studies.

1. *Plain Studies.* An intracranial aneurysm in any location may be responsible for three major types of alteration of the plain roentgenogram.

A. *Signs from general increase in intracranial pressure:* General convolutional or pressure atrophy of the inner table of the skull and separation of the cranial sutures were noted by Heuer and Dandy (1916) in the case of a basilar artery aneurysm compressing the pons. Similar nonspecific changes resulting from a general rise of intracranial pressure were noted by Alajouanine, Le Beau and Houdart (1948).

B. *Signs of local bone erosion:* Although such changes have been recorded for aneurysms arising from the anterior half of the circle of Willis (Heuer and Dandy, 1916; Schüller, 1918; and Kirby, 1924), no certain examples of this sign have been caused by basilar artery aneurysms.

C. *Calcification within the aneurysmal lesion:* The calcified wall of a carotid artery aneurysm which appears as a series of heavy shadows in the roentgenogram was illustrated by Heuer and Dandy in 1916. Confirmation of such roentgenographic appearances of the calcified aneurysm came from Schüller (1918) who described the "domelike contour of calcified plates within the wall of the lesion bent over the entrance to the sella" (p. 210).

Sosman and Vogt (1926) discussed the characteristic nature of the calcification occurring in such lesions. Writing of those aneurysms in the parasellar region, they say, " . . . One can see their plaques of calcium, usually semilunar in shape with their convexity upward. . . . These are fine curvilinear shadows, sharply outlined, occasionally segmented, and easily recognizable as being in the wall of a cystic or rounded structure" (p. 127). Similar calcification of basilar artery aneurysms has not been described in any detail.

2. *Special Studies.* Special roentgenographic techniques may reveal the following:

A. *Ventricular enlargement:* Internal hydrocephalus accompanying basilar-vertebral aneurysms has been recorded and demonstrated by ventriculographic stud-

ies in cases presenting findings of a tumor of the posterior fossa and intracranial hypertension (Richardson and Hyland, 1941, and Globus and Schwab, 1942).

B. *Posterior fossa angiographic studies:* From the time of Krayenbühl's (1941) demonstration of aneurysm of the posterior half of the circle of Willis by means of vertebral angiography, it became clear that basilar-vertebral aneurysms could be expected to be similarly demonstrated. Thus Sugar, Holden and Powell (1949) presented the roentgenologic findings in 2 instances of basilar artery aneurysm visualized by vertebral artery angiography. Local changes in plain films were not present. In 1 of their cases carotid angiography demonstrated the upward displacement of one of the posterior cerebral and posterior communicating arteries which left a clear space behind the sella turcica. At the time of vertebral angiography this space was seen to be occupied by the aneurysmal mass.

Apart from the nonspecific changes resulting in those cases in which intracranial hypertension develops, neither the early nor recent reports have included examples of bone erosion or aneurysmal calcification (Guillain, Schmite and Bertrand, 1930; Yaskin and Alpers, 1944; Hoge, 1944; Richardson and Hyland, 1941; Alajouanine, Le Beau and Houdart, 1948; and Dandy, 1944). The roentgenologic diagnosis has depended upon the use of angiographic study.

The case presented in this communication corresponds closely in its clinical structure to that class of cases presenting with a chronic history and signs of brain stem involvement. No signs of intracranial hypertension were present. A clinical diagnosis without the aid of roentgenograms was not possible. Unlike the vast bulk of cases reported in the literature, this case was unique by virtue of the extensive "calcification" within the lesion as demonstrated by plain roentgenographic studies. This appearance of the calcification dictated the need for posterior fossa angiography. The latter procedure, although more difficult and hazardous than carotid angiography, disclosed with reasonable certainty the nature of the lesion in question.

Treatment of such a "tumor-aneurysm" of the basilar artery is best postponed until the signs of increasing intracranial pressure require a palliative decompressive procedure. A direct surgical attack upon the lesion is probably foolhardy, and indirect methods to decrease the pressure within the aneurysm by major vessel ligation would seem inadvisable in view of the strategic role of the basilar artery in supplying blood to the brain stem.

SUMMARY

A unique example of what is considered to be a large tumor-like basilar artery aneurysm which was diagnosed with reasonable certainty by plain and angiographic roentgenologic studies has afforded the opportunity to discuss the incidence, behavior, and diagnosis of such lesions. It is the rare tumor-aneurysm of this region which can be correctly diagnosed by roentgenographic means unless posterior fossa angiography is employed. The accurate diagnosis of the vascular nature of such a tumor mass in the region of the pons may preclude ill-conceived operative procedures.

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Vol. 71, No. 3

A NEW METHOD FOR CORRECTING DISTORTION IN CRANIAL ROENTGENOGRAMS

WITH SPECIAL REFERENCE TO A NEW HUMAN STEREOTACTIC INSTRUMENT*

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A CLEAR description of the distortion encountered in cranial roentgenograms in man and the need for its correction in stereotactic work is more comprehensible if one is acquainted with the stereotactic machines used in man and their operation. Such machines were first constructed by Spiegel and Wycis[9] and their collaborators. Talairach[10] (1949) and his group have built a machine by which they orient the desired intracerebral points exclusively with respect to ventriculograms and pneumoencephalographic outlines of the intracerebral structures. They felt that a stereotactic machine oriented to the classical external coordinates of Horsley and Clarke[4] (1908) was not feasible in the human. Recently, other workers have started to use stereotactic machines of their own design.[1,3,5,6,7] Additional bibliographic information can be found in the "Stereotaxic Atlas" of Spiegel and Wycis.[9b]

We have independently developed a new model of the human stereotactic machine, which combines rigid sturdy fixation with light construction and great simplicity in operation. Sagittal and lateral views of the instrument as first applied are presented in Figures 1 and 2. The initial fixation of the base (*A*) is accomplished with the ear support (*C*) and eye support and maxillary clamp (*E*). These supports are easily adjustable by sliding them on calibrated ways, and are locked in position by a simple cam-action lever. All attachments to the base (*A*) are made on lapped and calibrated V-ways (*X*). The V-ways on the bottom of the base are perfectly symmetrical and interchangeable. The total weight resting on the ear and eye sockets is 2.9 pounds.

The second stage in fixation requires the drilling through stab wounds of four shallow holes in the skull, each $\frac{1}{8}$ inch (3.175

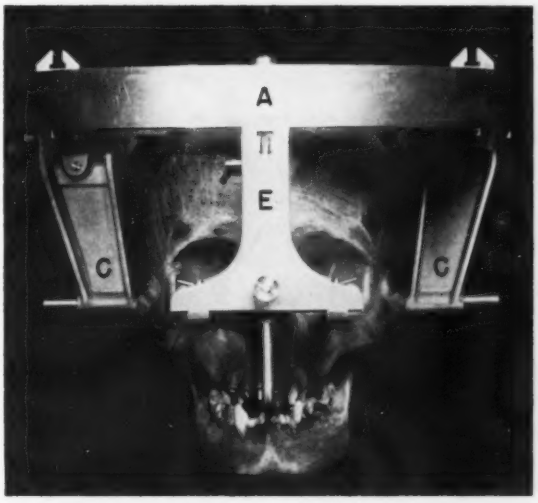

FIG. 1. A lateral view of the instrument as it is first applied to the head, with eye, ear and maxillary attachments in place.

A, base; *B*, bridge; *C*, ear support; *D*, skull support; *E*, eye support and clamp; *F*, cross slide; *G*, drill bushing; *H*, drill; *I*, needle plunger; *J*, cross pair grid; *X*, V-ways; *k*, intersection point of long lead cross hairs; *L*, sighting device; *Z*, lead globule simulating pineal gland. (These reference points refer to all the figures.)

* This machine and the special charts were constructed by Paul M. McPherson, 527 Main St., Acton, Mass., to whom all questions concerning their manufacture and distribution should be addressed.

Expenses partially defrayed by a Grant from the Damon Runyon Memorial Fund for Cancer Research, by a Grant from an anonymous donor, administered by Dr. James C. White, and by a portion of a Grant to the Massachusetts General Hospital by the American Cancer Society.

† Previously Post Doctorate Fellow, National Institutes of Health, and now Fellow of the Damon Runyon Memorial Fund for Cancer Research.

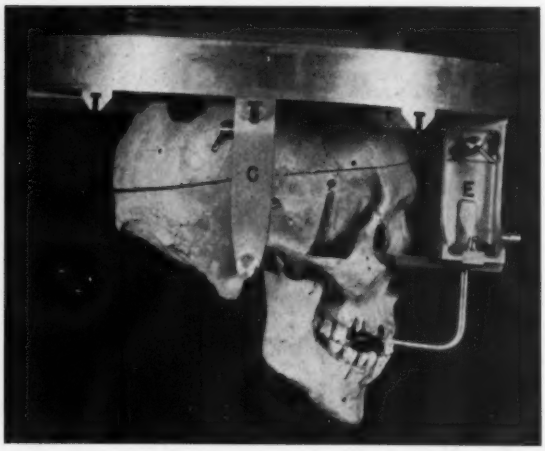

FIG. 2. A lateral view of the instrument with more detailed view of the V-ways.

mm.) in diameter (Fig. 3 and 4). The drill (*H*) has a shoulder which governs the depth of penetration. The drill is positioned by guide-bushing (*G*) which may be clamped to any of the V-ways on the underside of the base. As each hole is drilled the bushing is removed, and a skull support (*D*), the end of which is shaped exactly like the drill, is pushed into place and locked to the base. After the insertion of the fourth skull support, the ear supports, eye supports and maxillary clamps may be removed. At this point the instrument is rigidly fixed to the skull, so that one-thousandth of an inch motion between the instrument and the skull is impossible. This kind of rigidity is necessary to achieve a 0.1 mm. tolerance for positioning the needle within the brain. Figures 3 and 4 illustrate the appearance of the machine with only cranial fixation supporting the instrument. Chusid[2] (1948) suggested this tactic of fixing the frame to the skull so that the orienting pieces in orbit and auditory canal could then be removed.

FIG. 3. A sagittal view of the instrument with the skull supports in position, and the ear and eye attachments removed.

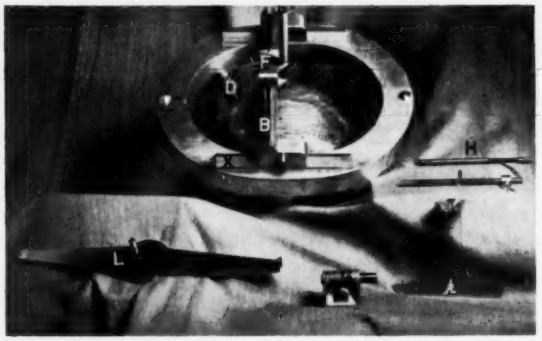

FIG. 4. A superolateral view of the instrument and its accessories showing especially the superior aspect of bridge and cross slide.

We then correlate our system of external coordinates with the position of an intracerebral structure as seen in a cranial roentgenogram or pneumoencephalogram. Absolutely true sagittal and lateral views of the skull are prerequisite to precise measurements for such correlation. These are obtained by placing the pair of attachments (one of which is illustrated at *J*, Fig. 4), into either the lateral or anteroposterior pair of V-ways. Each of these attachments consist of a transparent plastic plate attached to the standard clamp. Each plate contains two long strips of lead intersecting at right angles at the central point (*k*). Short lead strips at 1 cm. intervals lie at

right angles to each of these longer strips. We have called these attachments grids. The anteroposterior and superoinferior zero planes from which measurements are made, pass through the center of the external auditory canal. This virtually conforms with the original practice of Horsley and Clarke,[4] which we see no reason to change.* When the grids are applied at the sides, each point (*k*) is placed automatically so as to correspond with the center of its external auditory canal. Roentgenograms are then taken with these two attachments in place, projecting downward from the main frame of the instrument. Only if the corresponding lines of the two sides are superimposed does one have absolutely true lateral or sagittal views. To achieve this without loss of time, we have found indispensable the special sighting device (*L*).

Figure 5 is a roentgenogram with the instrument fixed to the cranial vault (orbital and ear attachments removed). It shows a true sagittal projection, *i.e.*, the vertical grid lines are superimposed, but the horizontal grid lines can be seen separately so that the plane joining the middle of the external auditory canal with the lower border of the right orbit is not quite horizontal, as it must be for these measurements. The shorter, sharply focused images are those of the lead cross-strips lying near the film. The larger, fuzzier lines are the images of the more distant cross-strips. They are actually of equal length, and they, too, lie only 1 cm. apart. The differences in magnification depending on different distances from the film are clearly illustrated thereby. Similar points are brought out in Figure 6—the lateral projection—in which both sets of the long grid lines are visible. Hence this not a true lateral view in either plane. We make our measurements from precise projections; these views are shown to illustrate the way in which such projections are made.

The initial fixation of the instrument to the cranial vault and the subsequent pneu-

* The "horizontal zero plane" of Horsley and Clarke was arbitrarily taken as the plane 10 mm. above the "base line" passing through the center of the lower margin of the orbit and the center of the external auditory meatus. Our "horizontal zero plane" is in the plane of their "base line."

Fig. 5. A sagittal roentgenogram of the skull showing the two grids in place—one anterior and one posterior on the skull-fixed machine. The cross-strips on the grid nearer the roentgen tube appear to be longer and more widely separated than those on the grid nearer the film. The pseudopineal gland is a globule of lead labelled *Z*.

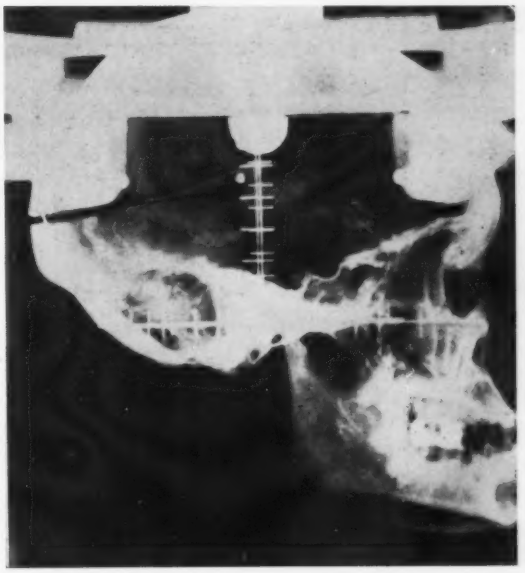

Fig. 6. In this lateral roentgenogram of the skull the grids lie on each side occupying the position originally used by the orienting pieces *C* to the external auditory meatus.

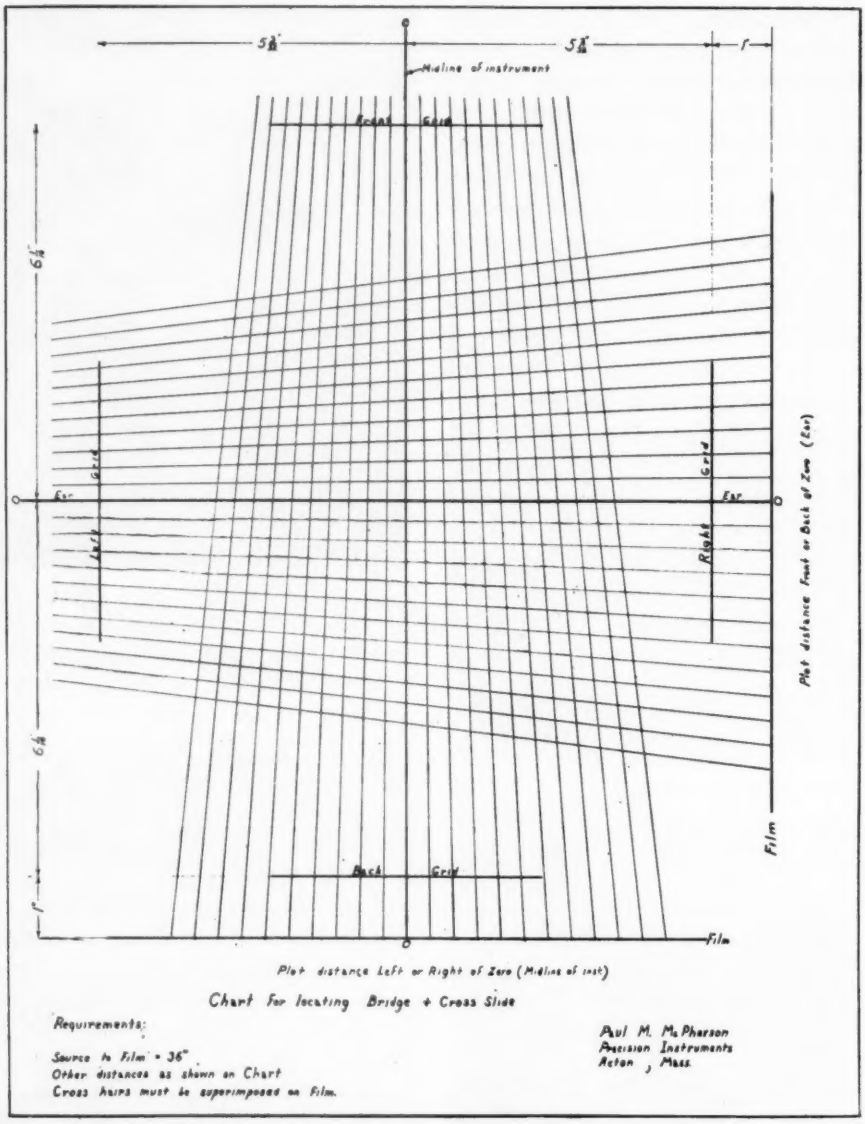

CHART I. This depicts the diverging roentgen-ray beams emanating from the left of the left grid and in front of the front grid. The grid separations are fixed by the anteroposterior and lateral diameters of the instrument. This chart is used for determining the position of grid and cross slide.

moencephalography are carried out with the patient under general anesthesia. At a later date the instrument can be painlessly reset into the cranial openings with the aid of marks on these cranial supports made at the time of the first placement. Since the total weight of the skull-fixed base, bridge, and cross slide is only 3.3 pounds, this is not a troublesome burden for a patient under local anesthesia, which is used at this time.

The roentgenograms yield a magnified image of the head because all but the central rays diverge at a constant angle as they leave the roentgen tube. The greater the distance between a point in the skull and the film, *i.e.*, the nearer that point is to the tube, the greater the magnification. Consequently, if we are to utilize the roentgenogram to guide us to a site in the brain, we must apply to any specific structures seen on that film certain correction factors.

These will be appropriate only to that locus, but it would be desirable to utilize this accurately localized point to spot any other normal intracranial structures as well. One of us (P.M.M.) has solved this problem using graphs. These depict precisely the degree of divergence of the various rays as they pass through the skull to reach the roentgen film. The charts have been constructed to full scale so that measurements on the roentgenogram may be transferred directly to the chart. We keep constant at 36 inches (91.44 cm.) the distance from the target of the tube to the film, as well as

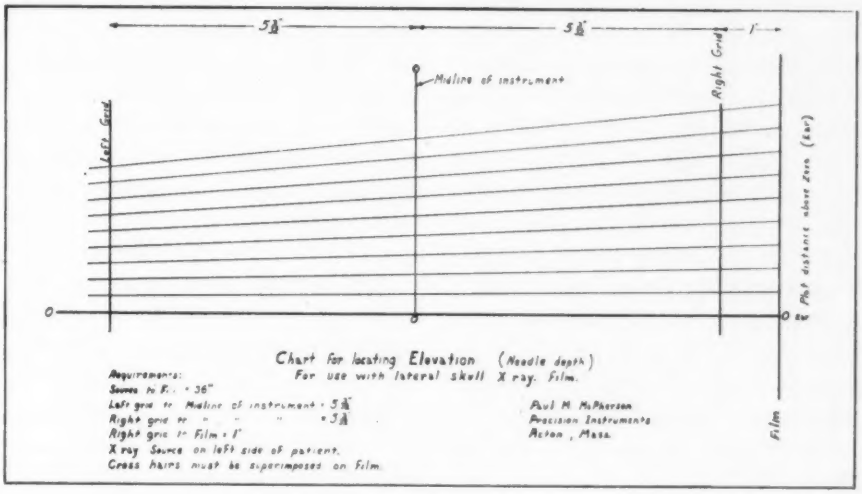

Chart IIA

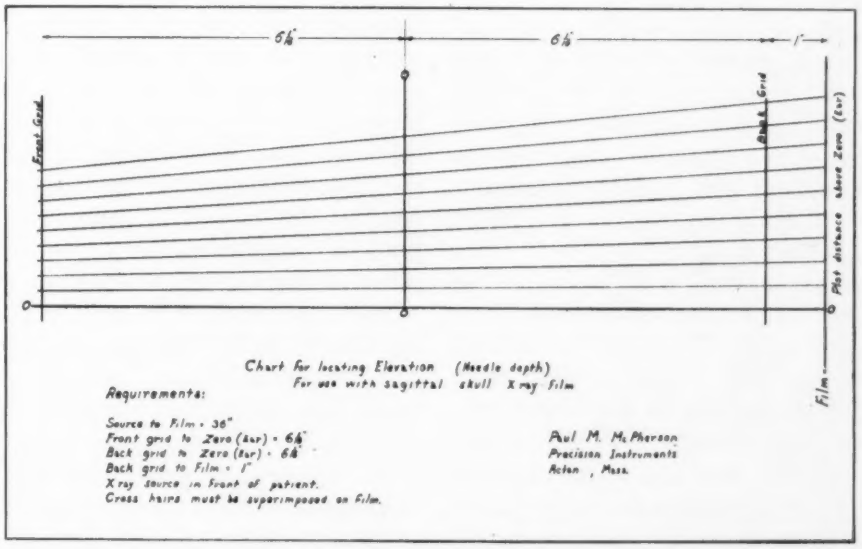

Chart IIB

CHART IIA. The measurement of needle depth plotted on the film line of this chart must be taken from the lateral cranial roentgenogram since it is a product of diverging beams passing from a tube on the left to a film on the right.

CHART IIB. In a similar fashion, the measurements taken for use in this chart must be read from the sagittal cranial roentgenogram, since it is a product of a diverging beam passing in front of the front grid to the plate behind the back grid.

Charts IIA and IIB provide a check on the measurements in Chart I and determine the position of the depth stop.

constant at 1 inch (2.54 cm.) the distance between film and the nearer grid. Thereby the graphs have universal applicability for this instrument under these conditions regardless of the size of the head.

In Chart I, when the roentgen tube lies to the left with the film to the right of the right grid, the roentgen rays are shown as lines passing roughly horizontally; when the tube is in front of the patient with the film at his occiput, the rays are shown as lines diverging from the top towards the bottom of the graph. This chart is used to determine (1) the anteroposterior plane of the electrode (the setting of the bridge, *B*, which moves fore and aft above the head), and (2) the parasagittal plane of the electrode (the setting of the cross-slide, *F*, which moves to either side of the midline). Chart II is used for determining the depth of the electrode; either of its two parts may be used alone, or both may be used—the one as a check on the other.

With this account of the instrument and its accompanying graph, we may now illustrate the location of a specific point, say point *Z*, a lead globule placed within the cranium at the site of the slightly displaced pineal gland. On the sagittal roentgenogram (Fig. 5) we measure the distance from the center of the shadow in question to the vertical grid line, that is, the longest lead strip in the mid-sagittal plane. This distance is now plotted in Chart I on the film line near the bottom of the chart (below the back grid). Then on the lateral roentgenogram (Fig. 6) the distance from the center of the shadow in question to the vertical grid line is measured and plotted on Chart I on the film line to the right of the right grid. If the points fall on grid lines of the chart, the point at which the grid lines intersect represents the true location of the point in the brain in relation to the zero planes of the instrument. In other words, a measurement from the vertical zero line of the chart to the crossing point on the chart represents the setting for the cross slide of the instrument. In a similar fashion, measurement from the horizontal zero line of the chart to the point of intersection represents the bridge setting for the instrument. These last measurements will not be along one of the divergent rays but will be made perpendicular to the respective horizontal or vertical zero lines. Thus the point has been located in two dimensions. The third dimension can be obtained either from Chart IIA or IIB for locating needle depth or elevation. This is accomplished by measuring the distance from the horizontal grid line to the selected point within the brain in the lateral cranial roentgenogram. Note that in a lateral view the rays pass from left to right so that the depth measurement taken from this view should be laid off on the film line related to the left-right grids. This lateral reference distance has already been obtained from the chart for locating the cross slide. This dimension is then laid off on the horizontal zero line in Chart IIA. A perpendicular to this is erected; the point at which it crosses the appropriate divergent ray projected from the point laid off on the film line represents the true elevation from the zero plane of the instrument to the designated point within the brain. A check on this datum is obtained if one measures the distance from the horizontal grid line to the selected point within the brain in the sagittal roentgenogram (Fig. 5). Here the rays are passing from front to back, as the depth measurement taken from this view is laid off on the film line related to the front-back grids. The anteroposterior distance obtained from Chart I for locating the bridge is now laid off on the horizontal zero line on Chart IIB. A perpendicular to this is erected; the point at which it crosses the appropriate divergent ray from the point laid off on the film line again represents the true elevation from the zero plane of the instrument to the designated point within the brain. The results from Chart IIA and IIB should agree. If they do, a selected point within the brain has been located 3-dimensionally and the needle plunger stop may be adjusted so that the needle will penetrate to the proper depth.

After the selected point within the brain is located on the chart, the bridge (*B*) is attached to the superior V-way and positioned in the anteroposterior plane. The needle plunger (*I*) is calibrated and has a depth stop, which may be set to control depth. This needle plunger is passed through the needle guide *FI* of the cross slide from the top. The needle plunger is set to accept a needle or electrode.

DISCUSSION

Although the description of this graphic method for correcting distortion in roentgenograms occupies several paragraphs, the application in practice requires only a few minutes. We have thought it worth while to present this account in advance of our use of it in living man, because it offers increased precision and simplification of tactics being employed by other workers in the field. For example, Schaltenbrand[8] is using special roentgenographic equipment to obtain less distorted lateral and sagittal views of the skull. The rays he uses pass through a lead slit which eliminates all the divergent beams in one plane, allowing only a narrow strip of film to be exposed at one time. Thus, in order to secure a complete view of the skull, many exposures are required with precise movement of the slit between each exposure. Although such side and sagittal views eliminate distortion in the anteroposterior and lateral planes, distortion does persist in the superoinferior direction. Spiegel and Wycis[9] have devised a method for defining two dimensions of an intracranial point by measurements taken in the mid-sagittal plane. The lateral dimensions, however, cannot be defined by their technique and they use postmortem histological measurements on an empirical basis.

Talairach[10] and his co-workers have been trying to avoid roentgen-ray distortion by moving the roentgen film 320 cm. away from the anode. They feel, at this distance, that the roentgen rays striking the film will be roughly parallel. However, one has merely to extend the full scale charts from our drawings at 36 inches, or 91.64 cm., to 320 cm. to realize that progressive distortion, although reduced in magnitude, is still present. For example, in a sagittal skull roentgenogram, a point 40 mm. to the right of the mid-sagittal plane and 42 mm. ahead of the intra-aural line would be seen at a point 52 mm. to the right of the mid-sagittal plane on the roentgenogram. This error of 12 mm. with a film-tube distance of 91.64 cm. would be reduced to 3.2 mm. with a tube-film distance of 320 cm. An error of 3.2 mm. would be outside the limit of tolerance for the accuracy of this method. In addition, this increased anode-film distance requires over an eleven fold increase of exposure time (as calculated by the inverse square law). Such an increased exposure time heightens the possibility of motion during the exposure, upsetting the perfectly true lateral and sagittal views necessary for measurement.

SUMMARY

We have described (1) a new type of stereotactic instrument for use in man, with improved methods for its application to the skull; (2) a simple means for correcting measurements from appropriately taken roentgenograms to position precisely an intracranial electrode.

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ADDENDUM

Since the original manuscript was accepted for publication, one of us (P.M.M.) has devised a modification of the roentgenographic plotting technique which makes it unnecessary to orient the patient so that the grids appear precisely superimposed on the roentgenogram. Occasionally numerous films were required before such accurate superimposition was obtained, and the improvement here described is a time saver. The method involves the placement of a chart of a head on a plotting board in exactly the same degree of rotation with respect to the central beam of roentgen rays as that obtaining in the roentgenogram. Once this chart has been thus affixed on the plotting board, measurements from the film are then transferred to it instead of to the charts described in the body of the paper. A freely movable transparent plastic straight edge rests on top of the chart. The straight edge itself represents the radius of a circle whose center is the roentgen-ray source. The base of this movable plastic unit describes an arc of that circle. As long as the edge of this arc is kept in contact with its two posts "*M*" and "*N*" on the plotting board, the radius will point to the source of the roentgen rays. In other words, the base of this plastic unit can be moved into a great number of positions and still be in contact with posts "*M*" and "*N*," and the straight edge will describe for each position the path of a roentgen-ray beam from its source 36 inches away. The straight edge is thus substituted for those lines in Charts I and II (in the body of the paper) that represent the roentgen-ray beams.

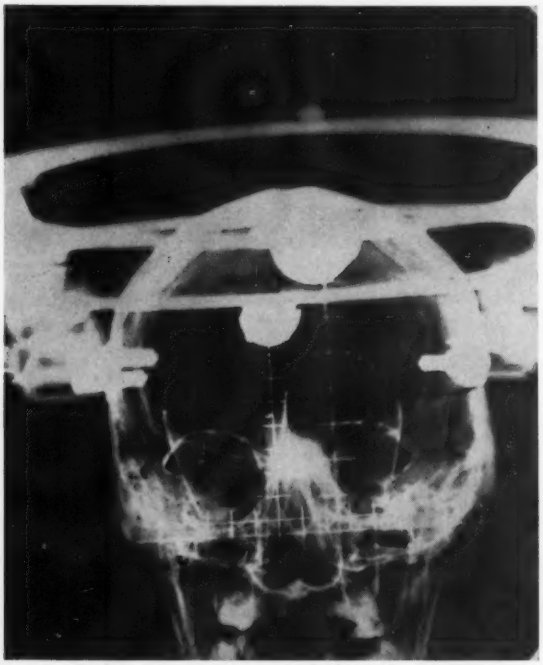

FIG. 7. This rotated sagittal cranial roentgenogram was taken without exact positioning of the skull.

In order to facilitate understanding of the modified method, we should like to explain the steps to the reader and then take him through them in succession, using the somewhat rotated posteroanterior view of Figure 7. The corresponding chart, lying on the plotting board shown in Figure 8, is fixed by a pin at a single pivotal point "*A*" which lies in the mid-sagittal plane of the grid nearer the film. The reason this point is used as a pivot is that it is the clearest and most readily identifiable point on the roentgenogram, and the skull-fixed machine and attached grids always appear rotated as a unit with respect to the film. The chart is first rotated into approximately the position of the head in the film by pivoting it in the appropriate direction until the straight edge passes through the center of the far grid line (point "*B*") and a point representing its projection on the line of the near grid. The chart is then fixed and the center of the image of the near grid (point "*A*")is plotted on the film line by means of the straight edge. The exact distance meas-

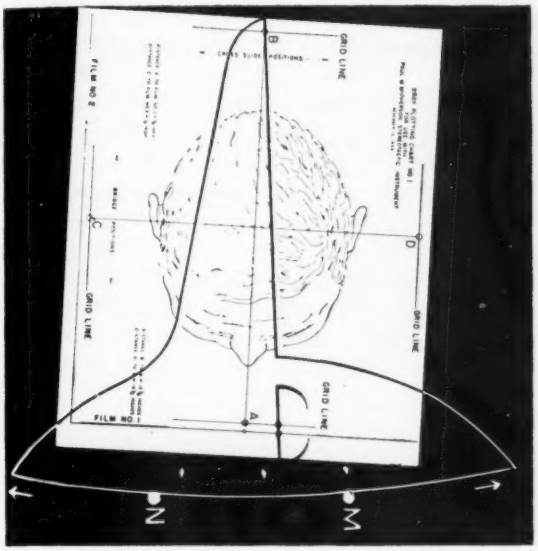

Fig. 8. Drawing board, plastic straight edge and plotting Chart I (addendum) are shown in the degree of rotation obtaining in the sagittal cranial roentgenogram of Figure 7.

ured on the film, between near and far grids, is plotted on film line No. 1, starting from the point just established as the projection of the near grid. The plotting on the film line of the distance between the images of the near and far grids establishes the place of the image of the far grid on the film line. The chart is further pivoted until the straight edge passes through the center of the far grid (point "*B*") and its precise image on the film line. The chart has now been rotated into precisely the same plane as the skull in Figure 7. The chart is then taped in place and measurements in the film from the grid to any desired intracranial point can be transferred directly to the film line. When the straight edge passes through this point, the exact position of the desired intracranial point will lie somewhere along the straight edge. This point is determined exactly by the second and third coordinates as described in the body of the paper.

The exact steps that one goes through to use this method are as follows:

(1) Put central pin through "*A*" and insert into hole in plotting board. This becomes the fixed pivot when adjusting the chart.

(2) Using compasses, measure the distance between the near and far vertical grid images on the sagittal roentgen film. Transfer this measurement to the near grid line (the line through point "*A*") on the plotting chart, measuring to the appropriate side of midline, starting from point "*A*."

(3) Holding the arc of the special straight edge in contact with posts "*M*" and "*N*" on the plotting board, adjust chart so that the straight edge passes through the point just marked and through far grid "*B*."

(4) Draw along straight edge from point "*A*" to film line No. 1. This intersection at the film line represents the corrected position of the near grid on the film with this degree of rotation of the head. Starting from this point the exact distance between near and far grid images on the film of Figure 7 is then laid off on film line No. 1.

(5) Adjust straight edge and chart so that the straight edge passes through the point just established on film line and far grid "*B*." The straight edge represents a roentgen ray passing through the chart exactly as the roentgen ray passed through the skull in the accompanying sagittal film. Any position of the straight edge may be set to duplicate any roentgen ray passing through the skull.

(6) The chart is now taped to the board. The distance between the near grid and lead globule on the roentgenogram may now be transferred to the film line of the chart (in the

XRAY PLOTTING CHART NO. 2
FOR USE WITH
PAUL M. McPHERSON STEREOTACTIC INSTRUMENT
NEEDLE ELEVATIONS
FILM NO 2
DISTANCE O TO C = 10½ INCHES
DISTANCE C TO FILM NO. 2 = ½ INCH

Fig. 9. Plotting Chart II (addendum) is used to determine the depth of needle penetration into the brain.

appropriate direction). Placing the straight edge on this point, a line is then drawn along the chart. The lead globule lies somewhere on this line. This step is identical to the one taken in the original paper to locate the lead globule when grid lines were exactly superimposed.

The second coordinate, the anteroposterior distance of the desired point from the interaural plane may be established by the duplication of this procedure, using the lateral roentgenogram and the chart of Figure 8 now turned at a right angle and pivoted on the central point (*C*) of the near grid. Finally, to obtain the superoinferior distance, a lateral roentgenogram is used, combined with the chart of Figure 9.

The main advantage of this technique over the one described in the body of the paper is that it permits taking the cranial roentgenograms without exact positioning of the patient. As long as the source-film distance remains at a predetermined setting (in our work, 36 inches) and all other distances remain as indicated on the charts, the position of the head is quite flexible as long as both grids can be clearly seen on the roentgenogram.

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EWING'S TUMOR OF A RIB WITH PULMONARY METASTASIS

REPORT OF A CASE WITH TEN YEAR SURVIVAL

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FIVE year survivals of patients treated for primary endothelioma of bone (Ewing's tumor) vary from Coley's[1] 6.1 per cent five year survival to Meyerding and Valls'[2] five year survival rate of 21.2 per cent. Coley states that metastatic pulmonary lesions from endothelioma are sensitive to roentgen therapy in contrast to other bone sarcoma lesions. In a review of the literature I can find no report of a probable cure (ten year survival) after roentgen treatment of pulmonary metastasis secondary to endothelioma of bone.

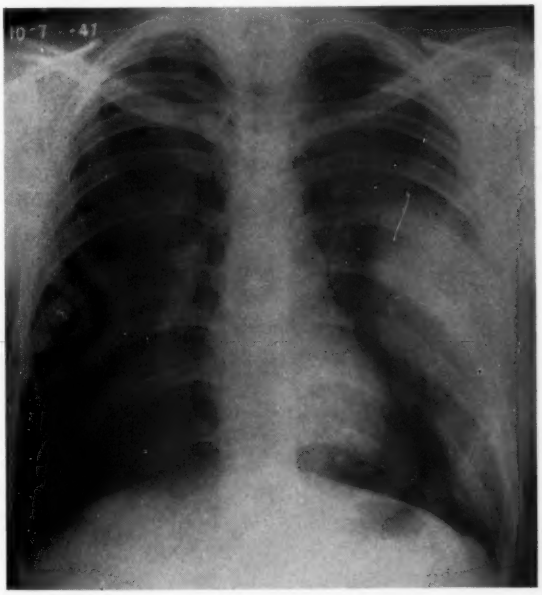

FIG. 1. Large mass involving seventh left rib.

In recent years there have been increasing reports of operative procedures for pulmonary metastatic lesions with 68 cases reported by Seiler *et al.*[3] in which there are no cases of endothelioma of the primary tumor.

FIG. 2. Potter-Bucky film after diagnostic pneumothorax showing detail of rib destruction and lack of visceral pleural involvement.

CASE REPORT

A fifteen year old white male was admitted to the Pennsylvania Hospital on October 6, 1941, complaining of a lump measuring 4 by 3 inches over the mid-portion of the left seventh rib, that had gradually increased in size for the past four months. It had become somewhat tender in the last two weeks and at night awakened the patient with pain.

The past medical history was irrelevant and his only positive physical findings were those concerned with the local lesion.

Physical examination of the chest wall revealed a tumor mass lying on the seventh rib in the posterior axillary line which was firm and elastic following the axis of the rib.

The mass was slightly tender, appeared attached to the rib and the skin moved freely over it.

Roentgen examination (Fig. 1 and 2) showed a thoracic mass involving a large portion of the seventh left rib. The rib is markedly changed by diffuse involvement of the shaft

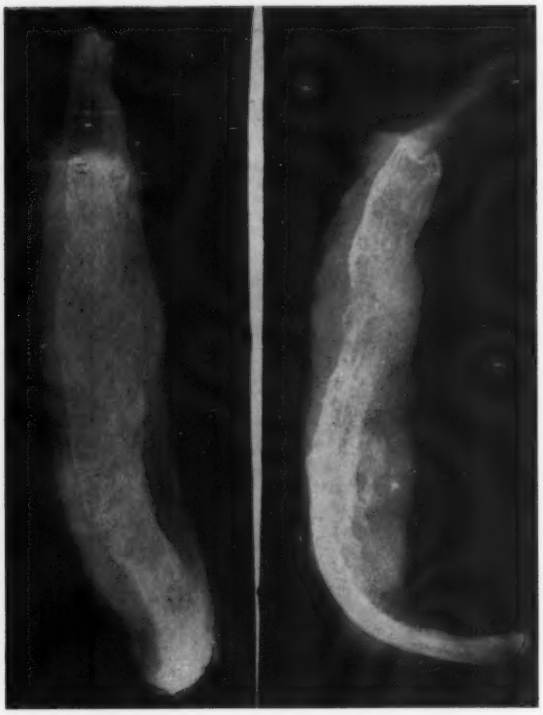

Fig. 3. Detail of the excised surgical specimen.

with widening due to both cortical and medullary changes. The shaft is honey-combed with an attached large soft tissue mass protruding into the pleural cavity. The impression was Ewing's tumor. "Onion peel" periosteal proliferation was not present.

A diagnostic pneumothorax was performed which demonstrated that the parietal pleura was not attached to the tumor. Biopsy was considered but it was decided that preoperative roentgen therapy followed by radical excision was the treatment of choice.

On October 16, 1941, roentgen therapy was started and a series of eleven treatments on alternate days was given using 200 kv., half-value layer 0.09 mm. Cu, two ports measuring 15 by 20 cm., one anterior and one posterior, crossfiring the tumor. An air dose of 2,050 roentgens was administered to each port.

On December 22, 1941, the patient was operated upon and the seventh rib and tumor mass removed. The postoperative course was uneventful.

The pathology report of the surgical specimen (Fig. 3 and 4) was endothelioma (Ewing's tumor) of the rib showing effects of roentgen therapy.

Fig. 4. Photomicrograph of surgical specimen.

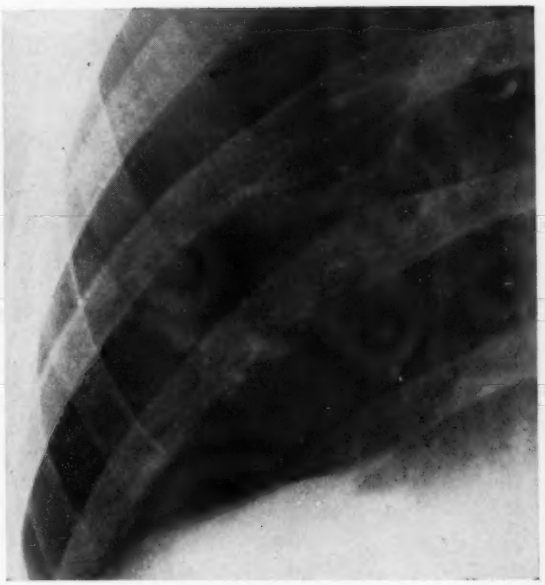

Fig. 5. Localized nodular lesions in the right base before roentgen therapy.

In July, 1942, during a routine follow-up examination, four small, round, discrete nodules were seen at the right base on the chest roentgenogram. The patient had no complaints and was gaining weight. These were followed until November, 1942 (Fig. 5) when it was certain they had increased in size and, based on the roentgenographic appearance and history, it was impossible to believe they could be other than metastatic nodules.

Between November 18 and December 4, 1942, 1,450 r (in air) was administered to the right anterior and posterior lower lung field through a 15 by 20 port using conventional 200 kv. roentgen therapy. An additional 1,400 r (in air) was given between January 7 and January 18, 1943.

Roentgen examination in February, 1943, revealed a residual increase in fibrosis but the distinct nodules were no longer present.

This patient has been under a continuous follow-up, completely asymptomatic for more than ten years; he attended college, has married and is the father of a fine son and leads an entirely normal life with no evidence of recurrence or metastasis. There is still slight fibrosis at the right lung base that has remained unchanged (Fig. 6).

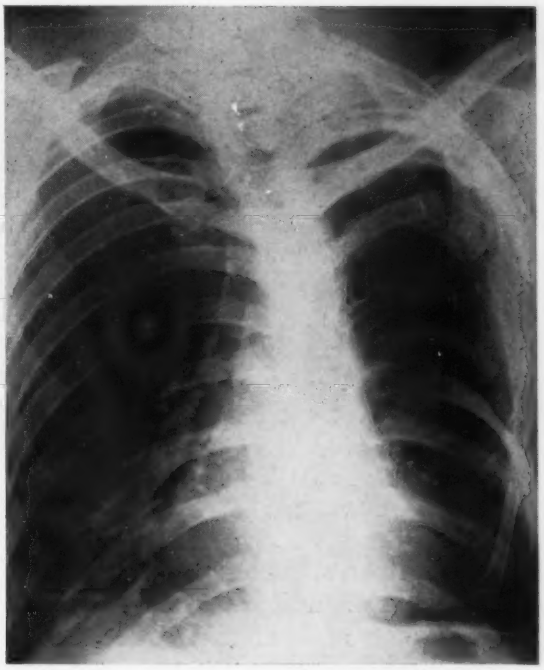

Fig. 6. Routine chest roentgenogram ten years after operation.

SUMMARY

A ten year survival has been recorded in a patient who had a Ewing's tumor of the rib, treated by preoperative roentgen therapy and surgical removal. Secondary chest metastasis to one lobe developed which completely disappeared following further roentgen therapy.

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STUDIES ON SPONDYLOLISTHESIS

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SPONDYLOLISTHESIS or slipping of a vertebral body in the lower lumbar region usually, with exceptions to be noted later, results from a bilateral defect in the neural arch at that level. Earlier writers held this defect to be congenital but subsequent studies cast some doubt upon this.[2] Stereoscopic oblique studies made partially supine but with the sagittal plane 45° to the horizontal, have, in my experience, accorded the best visualization of this defect.

Identification of the break in the isthmus is aided by recognition of a "cross" shadow, the vertical part of which is formed by the aligned fourth and fifth posterior articulations. The crux of the cross sign is that area, free of bone, lying between the tip of the fourth inferior articular process and the upper end of the sacral articular process. In certain cases, the sacral process is thrust upward into this space, even to the point of impinging upon the fourth inferior articular process. Various other compensating impingements offering additional support and stability may develop in this region. A "broken cross" shadow results when the fourth articulation is carried forward by the spondylolisthesis so that the fourth and fifth articular spaces are no longer in alignment. A shadow simulating a break in the neural arch may occur on the 45° oblique film if the roentgen tube is centered too far cephalad.

Except in cases of lordosis and spondylolisthesis the normal oblique roentgenogram visualizes the fifth posterior articulation beneath or anterior to those above it. For this reason an occult spondylolisthesis may be suspected even without roentgen confirmation of forward slipping in cases with fifth arch defect wherein the plane of the fifth posterior articulation lies well posterior to that of the fourth. Lateral roentgenograms in the standing position should be made of these patients.

In numerous cases with hiatus of the pars interarticularis we have been able to visualize a smooth, rounded, bony callus formation projecting from the defect medially and forward into the spinal canal. Considerable encroachment of the passage may result at this level. Some of these patients give a history of severe injury, others do not. Where present, such callus would seem to be evidence of a trauma that must have occurred after ossification, since healing of a fracture of cartilage does not produce bony callus. Callus formation has been denied by certain writers, although Schmorl shows a good example of this condition in a sixty-eight year old male cadaver. Radiologists in excellent papers have recently published roentgenograms showing this formation of the fifth neural arch but without mention of it as such.

The condition is visualized upon the posteroanterior roentgenograms as a dense shadow bulging medially into the lumen from the lateral wall of the spinal canal. On the 45° studies the posterior articulations of the lowermost side joined by their isthmus or pars interarticularis appear overlying the vertebral bodies. The profiles of the laminas of the neural arches of the opposite or uppermost side are seen posteriorly behind the spinal canal. If a callus is present it will be seen on the oblique view posteriorly, where it projects from the lamina forward into the canal. In this oblique view, if the patient, for instance, is lying with the right side lowermost the callus visualized will be on the left side of the canal (Fig. 1). In certain cases a small section of the lamina may remain attached to the pedicle and be carried forward with that structure. The profile of this fragment is flattened anteriorly and in the oblique study it must not be mistaken for the rounded bony callus mass above described.

Specimen No. 278 from the Terry Anatomical Collection showing a break in the fifth neural arch has a large bony mass at-

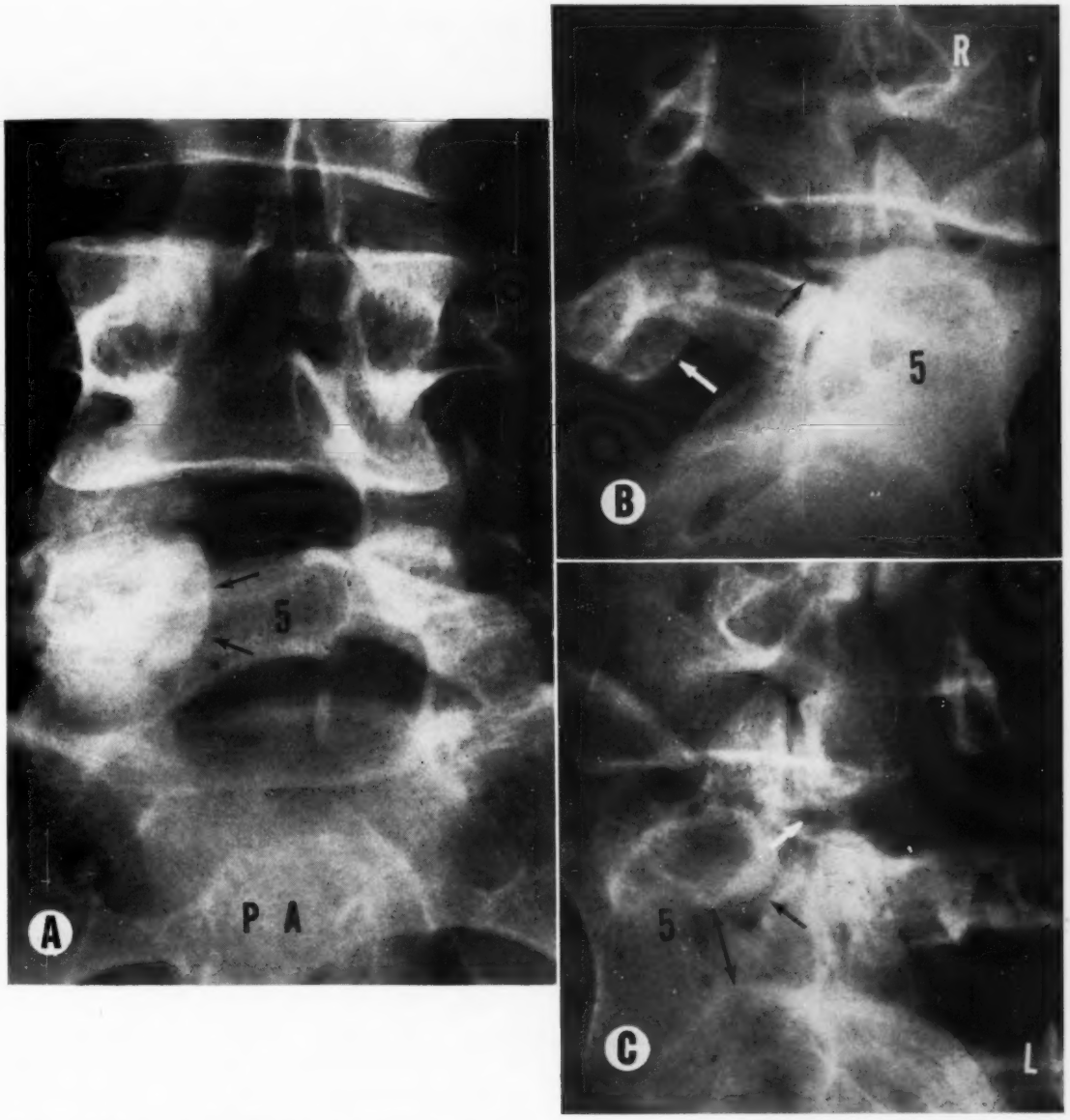

FIG. 1. Male, aged twenty-nine. Sciatic pain exaggerated by sneezing. Some low back pain with limitation of motion. This patient has bilateral breaks in the 5th neural arch as seen in the oblique views. The posteroanterior view (*A*) shows a rounded callus-like bony mass projecting from the left side into the spinal canal (black arrows). In the right oblique projection (*B*) this same bony mass is seen extending from the lamina forward into the canal (white arrow). The left oblique projection (*C*) visualizes the break in the 5th neural arch (white arrow). This is a case of occult spondylolisthesis, *i.e.*, no forward slipping was visualized upon the lateral film but the plane of the 5th posterior articulation is seen well posterior to that of the 4th in both oblique studies. The oblique views also show compensatory stabilizing bony impingement. On the left side this is seen between the 5th pedicle and the sacral articulation (black arrow) while the right oblique shows the stabilizing impingement between the 4th articular process and the lamina of the 5th neural arch (black arrow). Both oblique projections also illustrate the "broken cross" and the left one especially shows constriction of the foramen between the 5th pedicle and ala of the sacrum (double headed arrow).

Fig. 2. Male, aged sixty-three. Lordosis, limited lumbar movement, right sciatica, diminished Achilles reflexes. The film reveals degeneration and thinning of the first and second lumbar discs, but with intact posterior joints. As a result, backward displacement of the corresponding vertebral bodies has occurred. This retro-spondylolisthesis has produced bony encroachment of the corresponding intervertebral foramens. The arrow indicates an old fracture of the 5th neural arch with forward slipping of L5 and a compensatory bony shelf formation at the anterior portion of the lumbosacral disc.

tached to the left pedicle. In our own material one specimen showed bony excrescences within the canal opposite the neural arch break, probably from rubbing of the bony surfaces together. In one of our specimens also with spondylolisthesis there was a separate ossicle, 0.5 by 1.0 centimeter in size within the ligamentous tissue bridging the arch defect. A case similar to this in a patient complaining of nerve root pressure symptoms was operated on by Pheasant.[1]

Instability or degeneration of a lumbar intervertebral disc with thinning of that structure may result in a slipping of the supra-imposed vertebral body either forward or backward. If the posterior articulations remain intact, the inclined planes of these structures are likely to force the vertebral body backward so that a reverse or retro-spondylolisthesis develops. At times the involved disc is wedge shaped with the narrow edge posteriorly. The superior articular processes from the underlying vertebra usually become thrust upward and forward into the intervertebral foramens producing encroachment upon the lumens of these openings (Fig. 2).

If, however, a destructive arthritis of the posterior articulations occurs with instability of the disc, the slipping may take place in a forward direction, even without a defect in the neural arch. This constitutes the so-called pseudospondylolisthesis described by Junghanns in 1930. It most frequently occurs at the L_4 disc with thinning of that structure but it may occur at other levels. The oblique studies will show disc thinning with advanced arthritic changes involving the corresponding posterior joints. One may note more or less destruction of the superior articular process projecting upward from below. The tip of this process is lost, the plane of the articulation becomes more horizontal and it no longer restrains the vertebra above from the slipping forward (Fig. 3 and 4).

Forward spondylolisthesis with apparently intact neural arch may likewise occur rarely in other cases. One of these was in a child, aged twelve, with a second degree spondylolisthesis. She had no break in the fifth neural arch on either side but there was exaggeration of the lumbar curve. Reexamination eight years later showed the position unchanged except for some lessening of the lordosis. I believe this to be a case of congenitally long pars interarticularis

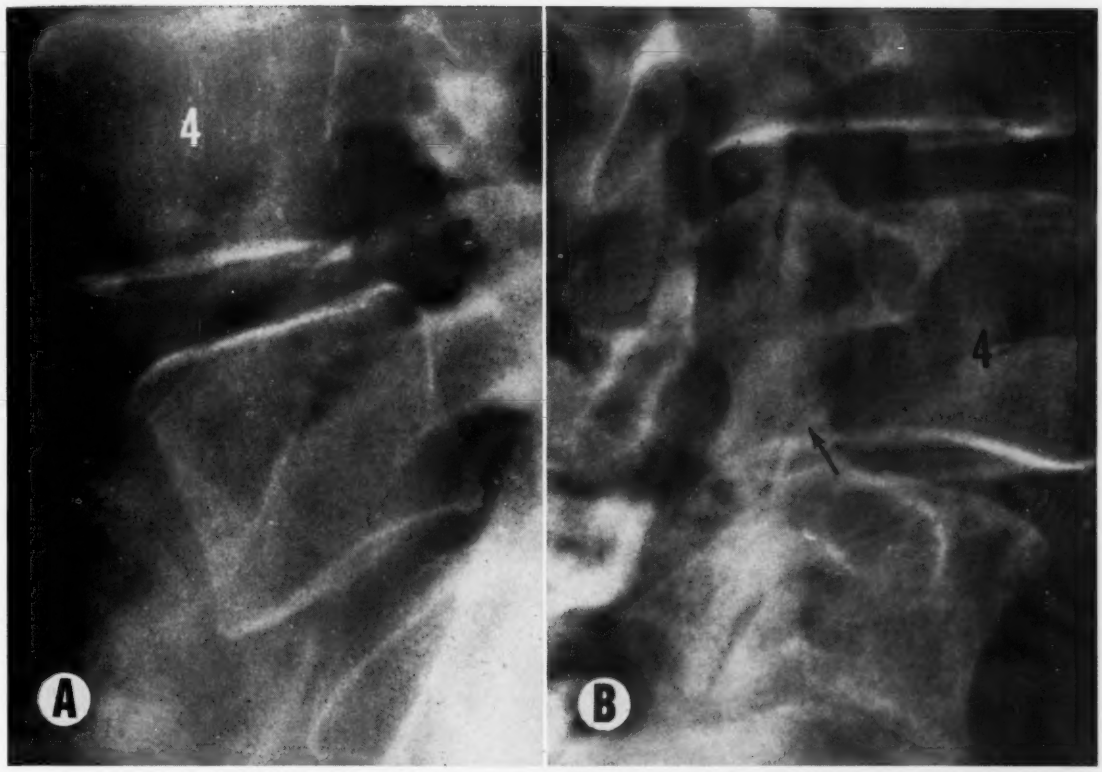

FIG. 3. Female, aged sixty. Low back pain—limited motion. (*A*) Lateral view showing pseudospondylolisthesis of L4 forward on L5. There is no break in the neural arch. The oblique view (*B*) shows the 4th posterior articulation partially destroyed. The tip of the 5th articular process (above black arrow) has completely disappeared.

FIG. 4. Specimen 489. Male, aged sixty-two. Pain in legs for eight years, pseudospondylolisthesis. Degeneration of 4th disc, intact 4th neural arch. Arthritic changes in the 4th posterior articulation. Compare this joint with those above and below it. Encroachment of the 4th intervertebral foramen with nerve changes shown by microscopic study.

Fig. 5. A case of spondylolisthesis in a young girl without any break in the neural arch. The right (*A*) and left (*B*) oblique studies made at twelve years show a long pars interarticularis with intact cortex on each side (white arrows). The lateral view (*C*) at twenty years revealed the forward slipping of L5 the same as it had been eight years before. This was probably a case of congenitally long isthmus with resultant spondylolisthesis and lordosis.

(Fig. 5). Another female patient, aged forty-four, with no obtainable history of injury showed a first degree spondylolisthesis with inact neural arch. There were dense bony calluses attached to the isthmus on each side, however. This is somewhat like the example shown by Schmorl and Junghanns.[3] In spite of the negative history this was probably an old healed fracture of the isthmus.

In cases of unilateral arch defect, a true spondylolisthesis seldom occurs, although the asymmetrical stress upon the arch may cause that part to develop greater density of bone structure. A defect on one side, however, may at times produce an occult spondylolisthesis or else the rotation type of displacement. The sacrum may be rotated backward on the affected side. This rotation can be noted by direct observation with the patient standing. Rotary spondylolisthesis may be described as a turning and slipping of the vertebra and/or its arch. This is due to imbalance and asymmetry in the stresses and stabilizing structures of the lower lumbar area.

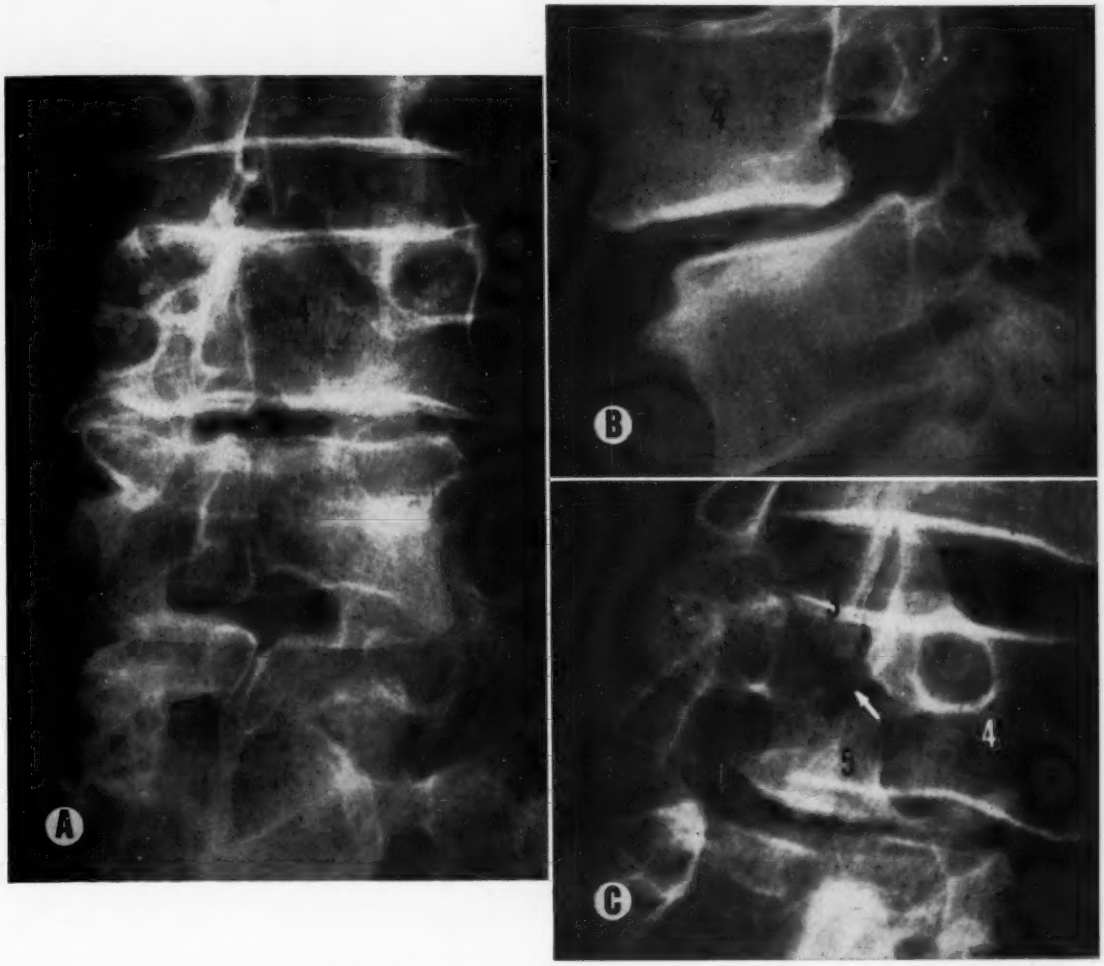

Fig. 6. (*A*) (*B*) (*C*). Male, aged thirty-nine. Patient fell off load of hay onto back at twelve years of age. Now has pain and paresthesia down both legs. Right side of pelvis is rotated backward. This patient has a rotary spondylolisthesis. Posteroanterior (*A*) and lateral (*B*) studies show the 4th vertebral body subluxated forward and toward the right side. In the right oblique view (*C*) a wide break in the 4th isthmus (white arrow) is seen between the tips of the 3rd and 5th articular processes. This widened defect has allowed the backward rotation of the sacrum and pelvis on the right side. This oblique view illustrates the "cross" sign.

Various types of rotation may occur. In one case a widened defect in the right fifth isthmus allowed backward rotation of the right side of the sacrum carrying the fifth spinous process to the left of the midline. In a similar case at the L_4 level the vertebral body was displaced forward and to the right while the sacrum was rotated backward on the affected side (Fig. 6). In a unilateral case with left fifth arch defect a partial collapse occurred so that the left side of the fifth body became elevated by rotating about on an anteroposterior axis. Of considerable interest was the patient with a break in the fourth arch on the left side and a destruction of the fourth posterior articulation on the right. This bilateral loss of stabilizing function had allowed the fourth intervertebral body to rotate forward and to the left about the intact fifth posterior articulation as a center. This rotation of L_4 carried the supra-imposed lumbar spine with it.

SUMMARY

1. The value of the 45° oblique roentgenogram is emphasized.

2. A "cross shadow" is described which

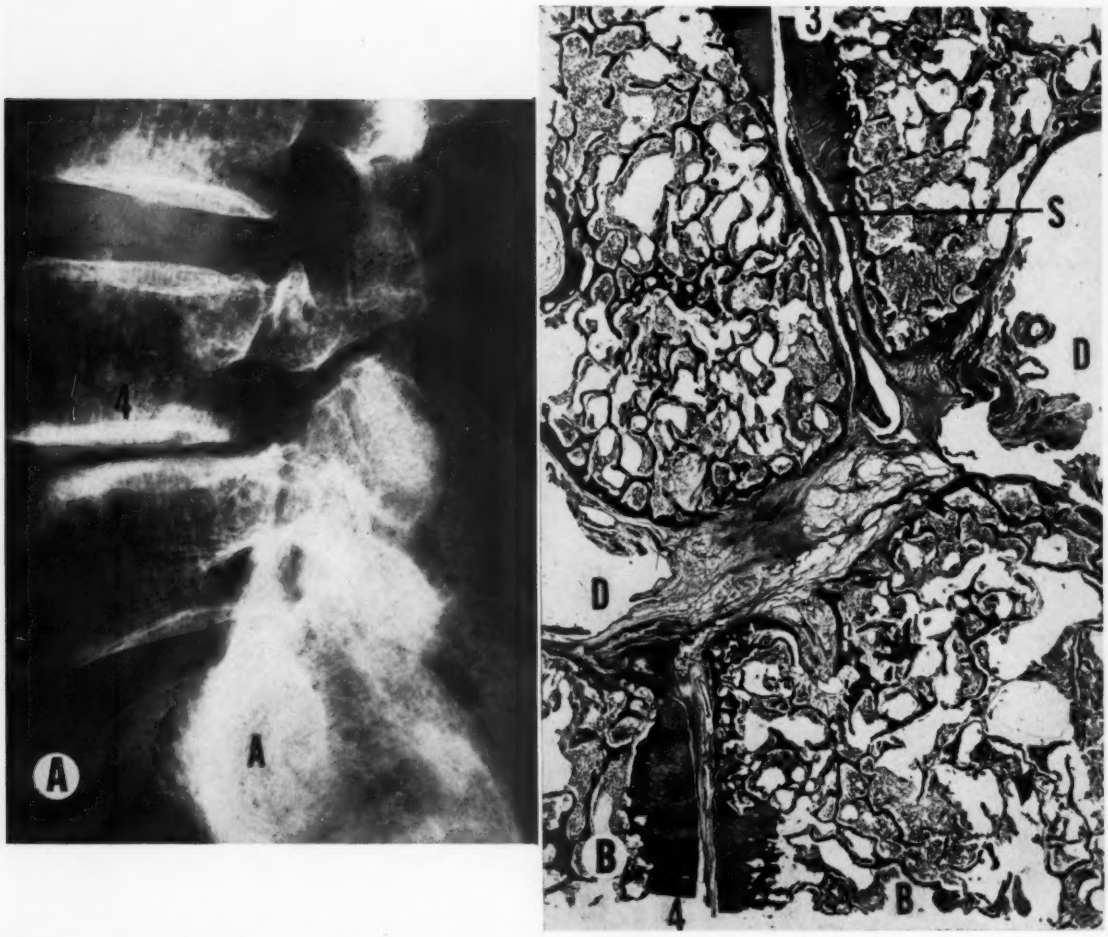

Fig. 7. (*A*) Specimen No. 5210. Male, aged seventy-eight. Roentgenogram showing spondylolisthesis from a break in the 4th neural arch and degeneration of the 4th disc. (*B*) Section through the break in the 4th neural arch. This defect is seen passing diagonally across the mid-portion of the field (D–D). It contains only fibrous tissue. There is no true joint surface or cartilage between the two parts of the 4th arch but in both the roentgenogram and the section one may identify a distinct cortex on each side of the deficiency. Within the fibrous tissue are a few small open spaces lined with a single layer of cells. At the edge of the section above and below are cartilages of the 3rd and 4th posterior joints (3 and 4). A long tab of synovia (s) projects into the former. Pinching of these common synovia tabs between the articular surfaces is cited as a cause of the sudden acute pain which at times may follow stooping.

assists in recognition of the neural arch defect.

3. Bony callus is frequently visualized as a mass projecting into the spinal canal opposite the break in the neural arch. On the oblique films this is seen posteriorly.

4. Instability and thinning of an intervertebral disc predisposes to reverse spondylolisthesis with foramen encroachment if the posterior articulations are intact.

5. Disc instability with posterior joint destruction allows forward slipping, even without arch defect, usually of the fourth lumbar, the so-called pseudospondylolisthesis.

6. Spondylolisthesis with intact neural arch is also seen with a congenitally elongated isthmus, or in cases of old healed fracture of that structure with a forward displacement of the vertebra.

7. In the absence of lordosis an occult spondylolisthesis may be suspected in patients with a fifth arch defect wherein the fifth posterior articulation lies well pos-

terior to the plane of the fourth. This type may be present as a backward rotation in cases of unilateral defect.

8. Rotary spondylolisthesis, a turning and slipping of the vertebra, is caused by an asymmetrical imbalance in the stabilization of the lower spine.

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I am indebted to Dr. Mildred Trotter and to Dr. Maurice B. Roche of the Department of Anatomy, School of Medicine, Washington University, for the privilege of using material from the Terry Anatomical Collection. Also, Dr. Philip B. Armstrong, Professor of Anatomy, and Miss Stella Zimmer of the Photographic Department of New York State College of Medicine at Syracuse have rendered invaluable assistance in the culmination of these studies.

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FRACTURES OF THE ANKLE

III. GENETIC ROENTGENOLOGIC DIAGNOSIS OF FRACTURES OF THE ANKLE

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BY ROENTGENOGRAPHY of the ankle in the anteroposterior plane, many more or less complicated methods of placing the foot and crus have been suggested, but none of them have become extensively and constantly used.

In order to obtain as well defined and uniform roentgenograms as possible, the foot is elevated 5 cm. from the support, pronated to the greatest possible extent, and dorsiflexed, and placed so that the medial margin of the foot is vertical in this position. The central ray is directed vertically against the ankle joint and parallel with the medial margin of the foot.

By turning the maximally pronated and dorsiflexed foot, so that the medial margin of the foot is vertical, the anteroposterior axis of the malleolar fork (tibiofibular mortise), which forms an angle of approximately 23 degrees to the sagittal plane of the extremity, will be turned completely into the anteroposterior direction. The malleoli will then be exactly in the frontal plane. The vertical central ray will thus be parallel with the articular surfaces of the malleoli and talus, so that the joint spaces between these parts will be uniform and always distinct and clearly defined (Fig. 1).

Fig. 1. Foot pronated and dorsiflexed with medial margin of foot vertical.

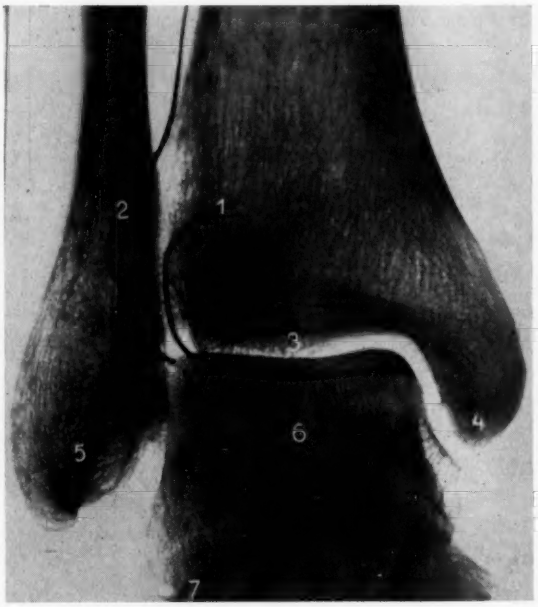


Fig. 2. Anteroposterior roentgenogram of ankle joint region (Grashey). Lateral limits of tuberculum anterius and tuberculum posterius tibiae are marked with wire. *1*, tuberculum posterius tibiae; *2*, tuberculum anterius tibiae; *3*, joint space of talocrural joint; *4*, medial malleolus; *5*, lateral malleolus; *6*, talus.

In the anteroposterior view (Fig. 2) the contours of tubercula tibiae are marked with a thin wire in order to outline their location in relation to the fibula and the syndesmotic space.

By external rotation of the crural bones, tuberculum anterius tibiae will overshadow the fibula to a greater extent and by internal rotation to a smaller extent than is the case in the ordinary anteroposterior view.

In the anteroposterior view it is not the distance between the medial surface of the fibula and the contour of tuberculum posterius tibiae which represents the width of the clear space ("la ligne claire"), but the space is demarcated by the medial surface of the fibula and the densest lateral contour of the tibial shadow. This latter is not indicated by any definite point of the tibia, but by the fairly plane surface of the fibular notch which, in the anteroposterior view, will appear as a linear contour, as the surface in this projection will largely be parallel with the central ray. By rotation of the tibia this contour will be blurred and ill defined.

The width of the syndesmotic space, the extent to which tuberculum anterius tibiae overshadows the distal part of the fibula, and the distance between the two tubercula have been the objects of many studies and calculations in order, if possible, to find an expression of the presence of ligamentous injury of the syndesmosis and "diastasis" (see Fig. 3).

Svend Hansen criticizes the measurements and computations published by Chaput.[3] Later Husfeldt[7] does the same and shows that there is such an essential discrepancy between the measurements suggested by Chaput,[3] d'Aubigné and Smets,[10] and Ashhurst and Bromer[1] that they are only of little importance and value in the diagnosis of syndesmotic rupture and diastasis anteriorly in the syndesmotic space.

It is easy to see that these measurements must give unreliable results, bearing in mind, as pointed out here, that the contour of the tuberculum posterius is difficult, very frequently impossible, to determine (Cf. Chaput's[3] definition of "la ligne claire"), that the size of the shadow of tuberculum anterius varies considerably by rotation of the tibia, and that the medial limit of the clear space ("la ligne claire") is not a line but the surface in the fibular notch.

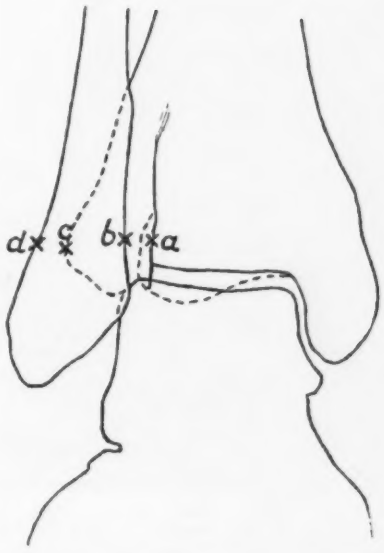


Fig. 3. Diagram of anteroposterior roentgenogram of ankle joint region. *a*, contour of incisura fibularis tibiae; *b*, tibial contour of fibula; *c*, contour of tuberculum anterius tibiae; *d*, lateral contour of fibula.

Note: Contour of tuberculum posterius tibiae runs fibulaward to "*a*" and is represented with a dotted line.

ab = "la ligne claire" = Chaput I.—Normally not exceeding 3 mm.

bc = Overshadowed part of fibula = Chaput II.—Normally not less than 10 mm.

$\frac{ab}{ac} = \frac{\text{"la ligne claire"}}{\text{intertubercular distance}}$ = d'Aubigné and Smets. Normally not exceeding $\frac{1}{3}$–$\frac{1}{2}$.

$\frac{cd}{bd} = \frac{\text{Unobscured part of fibula}}{\text{Entire width of fibula}}$

= Ashhurst and Bromer. Normally not exceeding $\frac{2}{3}$

ab of affected and not affected side = Husfeldt I. Normally difference less than 2 mm.

ab = 5 mm. and more = Syndesmotic rupture = Husfeldt II.

According to Husfeldt, diastasis is present when the difference between the syndesmotic spaces of the affected and unaffected sides is more than 1 mm., or when "la ligne claire" is 5.5 mm.

As far as the former of these statements is concerned, it may be observed that in the anteroposterior exposures from 100

FIG. 4. Oblique spiral fracture in the supramalleolar part of the fibula. The increase of width of the syndesmotic space is 2 mm. and due to internal rotation of proximal fibular fragment. No lesion of the ligamentum interosseum tibio-fibulare and no diastasis.

patients with oblique spiral fracture distally in the fibula just above the lateral malleolus a widening of the syndesmotic space of 1–2 mm. (measured between the proximal fibular fragment distally and the lateral tibial contour at the fibular notch) was found in 67 cases in spite of the fact that in this fracture there is no rupture of ligamentum interosseum tibio-fibulare, which holds this fragment against the tibia

FIG. 5. Unaffected extremity for comparison.

(Fig. 4 and 5). This widening of 1–2 mm. of the syndesmotic space does not occur as a result of displacement, but is due to internal rotation of the proximal fibular fragment. If the oblique spiral fracture has occurred, a disturbance of the attachments of the entire fibula takes place. The insertions of the ligamentous system and the septa giving origin to the muscles on the fibula corresponding to the proximal fragment are of such a nature that the tension in them under normal conditions tries to counteract the externally rotating force by which the talus in the act of walking or in movements of the ankle joint affects the

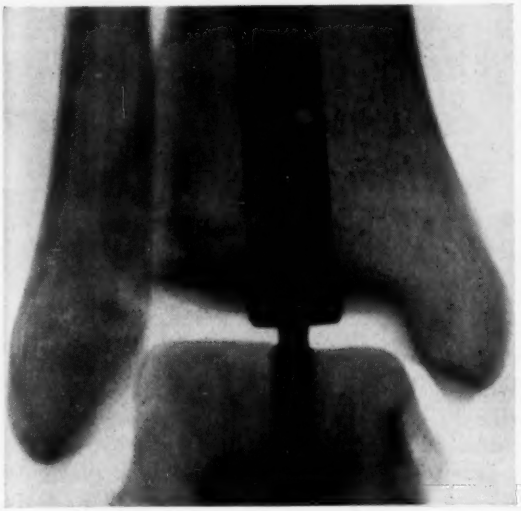


FIG. 6. Anterior view of a specimen with the fibula in normal position to the tibia.

lateral malleolus. When a separation between the lateral malleolus and fibula has occurred, the proximal fibular fragment may be moved more freely and be rotated inward to such an extent as the tension of its ligamentous system allows. That the form of the fibula makes a roentgenologically wider space between the fibula and tibia possible in inward rotation, and a narrower space in outward rotation can be illustrated by roentgenograms of a specimen with the tibia and fibula in normal position and with the fibula rotated outward and inward respectively (Fig. 6, 7 and 8).

If there is a supramalleolar fracture in

the fibula distal to the lig. interosseum tibio-fibulare a difference of 2 mm. between the syndesmotic spaces of the affected and unaffected ankle (Husfeldt's first statement) does not mean syndesmotic rupture but increase of the syndesmotic space due to inward rotation of the proximal fibular fragment.

In the absence of fracture of this nature a difference of more than 1 mm. (Husfeldt's first statement) probably indicates syndesmotic rupture.

Husfeldt's second statement, that a syndesmotic space of 5.5 mm. indicates diastasis, is undoubtedly correct. Now the

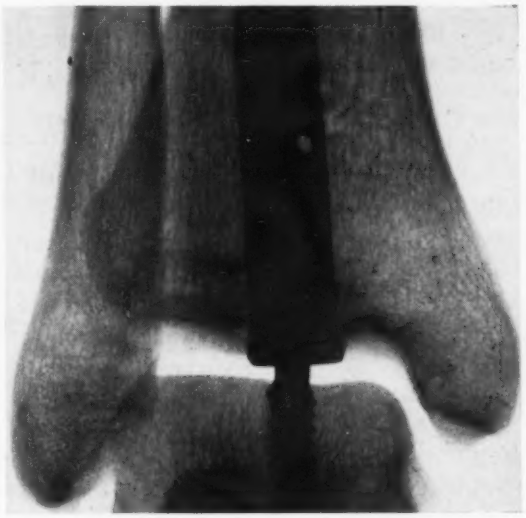


Fig. 7. Fibula rotated outward

question is whether syndesmotic rupture and diastasis, if any, may be present when the syndesmotic space is less—indeed, considerably less—than 5.5 mm. In order to answer this question I have produced a pronation-eversion fracture, Stage II, *i.e.*, fracture of the medial malleolus and detachment of ligamentum malleoli lateralis anterius and the ligamentum interosseum tibiofibulare. In anteroposterior views of the specimen, partly where the fibula is normally situated in the fibular notch, partly where the fibula is rotated outward, so that pathologico-anatomically there is a syndesmotic space anteriorly of more than 1 cm. (*i.e.*, diastasis), only a slight difference

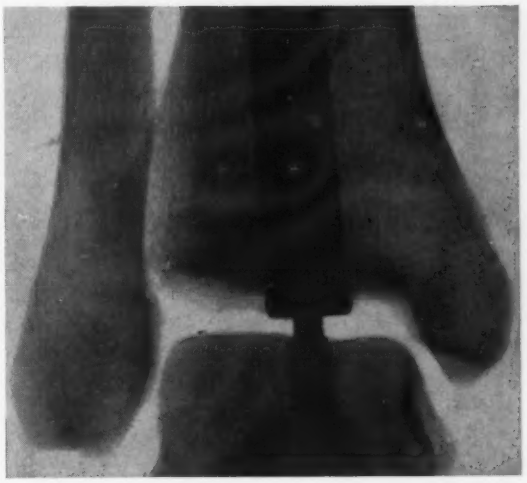


Fig. 8. Fibula rotated inward. Note the wider syndesmotic space due to the inward rotation of the fibula.

in the syndesmotic space was found in the roentgenograms (Fig. 9 and 10). The fibula is overshadowed by tuberculum anterius tibiae almost to the same extent in both roentgenograms.

If roentgenograms of the same specimen are taken without and with considerable diastasis anteriorly between the tibia and fibula, but with the crural bones rotated inward or outward around the longitudinal axis, the fibula is overshadows by the tuberculum anterius tibiae to a smaller extent by inward rotation, and to a greater extent by outward rotation, but there is practically no difference in the width of the syndesmotic space.

Thus, there may be a marked degree of diastasis anteriorly between the bones, without the roentgenological syndesmotic space being as wide as 5.5 mm.

This fact illustrates the doubtful value of Husfeldt's second statement as a sign of syndesmotic rupture and of the presence of any diastasis anteriorly.

Husfeldt has shown that the value of the measurements suggested by Chaput, by d'Aubigné and Smets, and by Ashhurst and Bromer is very doubtful in diagnosing syndesmotic lesions and diastasis. Since the measurements of "la ligne claire" proposed by Husfeldt, as shown above, do

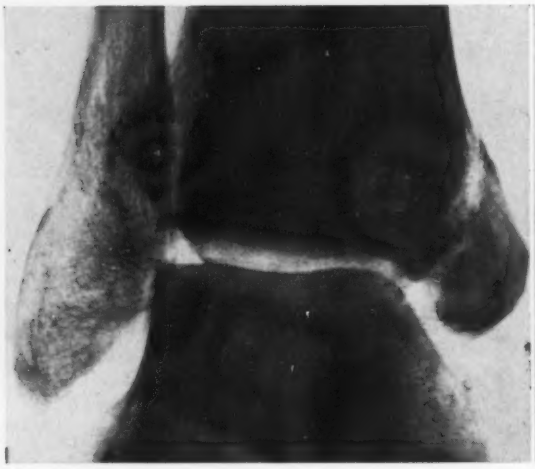


FIG. 9

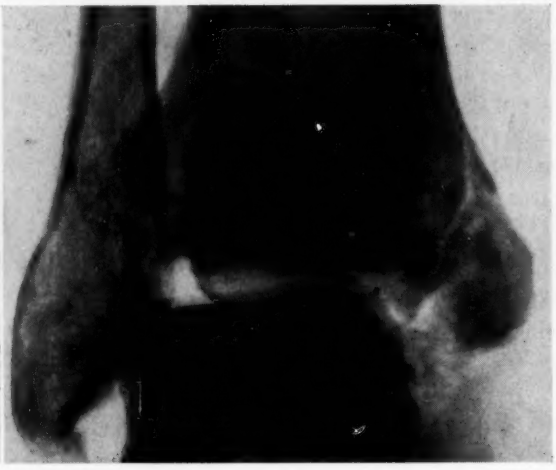


FIG. 10

FIG. 9 and 10. Ordinary anteroposterior view of the same specimen. Fig. 9. The syndesmotic space ("la ligne claire") approximately 2 mm. No pathologico-anatomical diastasis. Fig. 10. The syndesmotic space 3 mm. Pathologico-anatomical diastasis, 1 cm. anteriorly.

not present either safe criteria for the presence or absence of syndesmotic rupture and diastasis, I have tried to solve the problem in quite a different way by performing combined experimental-surgical and experimental-roentgenographical investigations,[9] the results of which are shown later in this paper.

FIG. 11. Lateral view (see text).

In roentgenography in the lateral plane the extremity is placed with the lateral aspect of the ankle region against the cassette. The foot is dorsiflexed and the tip of the foot is elevated 5 cm. from the support. The central ray is directed vertically against the medial malleolus, whereby the central ray will be parallel with the distal articular surface of the tibia (Fig. 11).

The joint space of the talocrural joint is seen with well-defined contours. The distal part of the fibula and the lateral malleolus are overshadowed by the tibia and talus. The shadow of the dorsal distal part of the tibia is seen dorsal to the posterior contour of the fibula.

It is important to note that the distal part of the fibula and the lateral malleolus are seen distinctly on a well exposed film, in spite of the fact that they are obscured by other bones, and that the anterior contour of the lateral malleolus lies somewhat in front of the anterior contour of the distal end of the fibula. It is important to know this because it plays a great role in the appreciation of the oblique spiral fracture, which is localized just proximal to the lateral malleolus, and which is seen best in the lateral view.

Another very important fracture can also be demonstrated only (or at least in

most cases only) in the lateral view, *viz.*, the fracture of the dorsal distal part of the tibia.

Ligamentum malleoli lateralis posterius distale ("the transverse ligament") is inserted in the close vicinity of the distal articular surface of the tibia at its dorsolateral corner and the lateral portion of the dorsal margin. The ligament is very strong, fairly short, taut, firm, of a cartilaginous consistency, inflexible, and is a component part of the malleolar fork (Fig. 12).

The ligamentum malleoli lateralis posterius is less taut, more elastic, and extracapsular and inserted into tuberculum posterius tibiae, the dorsal surface of the tibia, and the medial portion of the dorsal lip of the tibia (Fig. 12).

By my experimental-surgical investigations I found that bone injuries distally and dorsally in the tibia are invariably accompanied by detachment of the ligamentum malleoli lateralis posterius distale. In some cases, the ligament is detached with finely granular, osseous avulsions; in other cases —most frequently—with smaller or larger fragments carrying with them a smaller or larger part of the distal articular surface

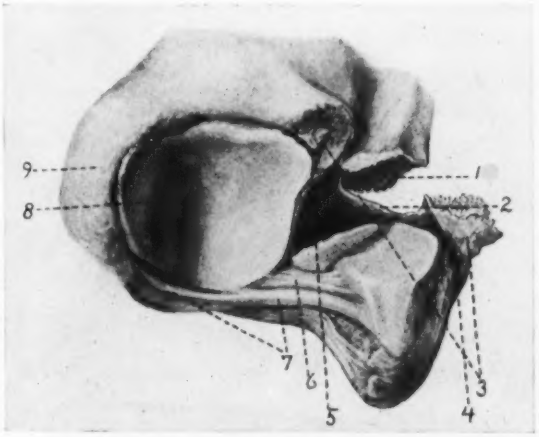


Fig. 12. Supination-eversion fracture, Stage II. *6*, Lig. malleoli lateralis posterius distale (the transverse ligament). (Note: The insertion in relation to the articular surface of the tibia and the lateral malleolus.) *7*, Lig. malleoli lateralis posterius. (Note: The insertion of the ligament along the entire posterior lip of tibia, and its posterior surface.) It is easy to distinguish from lig. malleoli lateralis posterius distale.

of the tibia. Where there is a real fragment, this never originates from the extra-articular dorsolateral corner of the tibia alone, but invariably also from a portion of the dorsal lip of the tibia corresponding to the entire tibial insertion of ligamentum malleoli lateralis posterius distale.

The difference in the nature and insertion of the two dorsal ligaments causes that lesion in the tibia corresponding to ligamentum malleoli lateralis posterius distale ("the transverse ligament") will always occur prior to lesion corresponding to the ligamentum malleoli lateralis posterius.

As the ligamentum malleoli lateralis posterius distale ("transverse ligament") is instrumental in the production of the fractures of the dorsal distal part of the tibia to such a considerable degree that the form of the fragment will be determined by the extent of the insertion of the ligament, it is evident that a fracture with a fragment avulsed from the dorsal, distal lip of the tibia will not only involve the dorsolateral corner, but also a portion of the posterior lip of the tibia itself.

From the above it will be evident that fractures dorsally in the distal part of the tibia will always involve the posterior lip of the tibia, and roentgenologically they will be demonstrable in the lateral view (provided that they are of a size which makes them visible on the roentgenograms). I have never observed the fracture which according to Husfeldt,[6] Grøndahl,[4] and Bircher [2] should be found in the dorsolateral corner of the tibia corresponding to the extra-articular tuberculum posterius tibiae. Facts that tell against the occurrence of this extra-articular fracture are the anatomical ligamentous attachments, the experimental-surgical investigations, proving that although fracture of the distal dorsal part of the tibia was produced by various mechanisms, extra-articular fracture of the tuberculum posterius tibiae never occurred, and finally the fact that I have never in any patient been able to demonstrate fracture of the distal dorsal part of the tibia in the

FIG. 13. Lateral oblique view (see text).

oblique lateral view, except when it was also visible in the lateral view.

By examination in the oblique lateral plane the extremity is placed as in the lateral view described above, but without elevation of the tip of the foot. The central ray is directed to the ankle region from the cephalic and dorsal side with the tube tilted 25–30° cephalad and dorsally. The focus film distance should in this case be decreased to 30–40 cm. (Fig. 13). Grashey has already emphasized the necessity of taking an oblique lateral view in order to differentiate the oblique spiral fracture of the distal end of the fibula from the fracture of the dorsal part of the tibia often running parallel with the former. Certain forms of fractures in the distal part of the lateral malleolus can be demonstrated with certainty only in films taken in the oblique lateral plane.

THE GENETIC ROENGTEN DIAGNOSIS OF ANKLE FRACTURES

Exact knowledge of the mechanism, pathological anatomy, and genetic roentgen classification of the fractures of the ankle has been obtained by way of fracture production, dissection, and roentgen examination in experimental investigations.[9]

Four types of ankle fractures were found which pathologico-anatomically occur in constant and characteristic stages, and which are found to correspond to all the clinical fractures of the ankle.

The four types of ankle fractures are described by a dual designation, which denotes the two main factors of the individual type of fracture, *viz.*, *the position* of the foot at the moment of fracturing and the *forced movement* of the foot producing the fracture.

The plan according to which the experimental fractures were produced and all the clinical ankle fractures can be classified is shown on the following page.

The four types* of ankle fractures are characterized by the location and form of the fibular fracture, and the stages in each individual type are determined according to the combination of the fibular fracture with other fractures involving the ankle region.

An exact genetic roentgen diagnosis of all ankle fractures is possible, and by determining the type and stage, the pathological anatomy is indicated also with regard to which ligamentous ruptures may be present in the different types of ankle fractures.

Below the pathological anatomy will be

* Supination-adduction, supination-eversion, pronation-abduction, pronation-eversion.

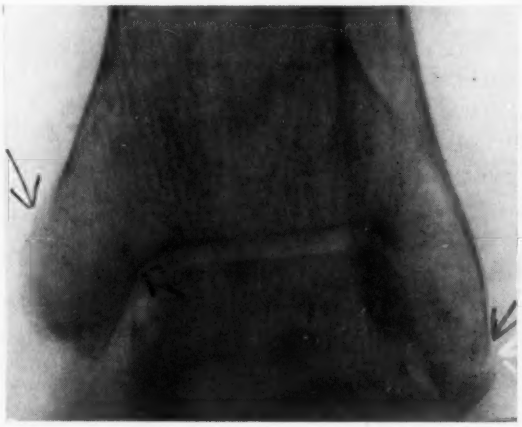
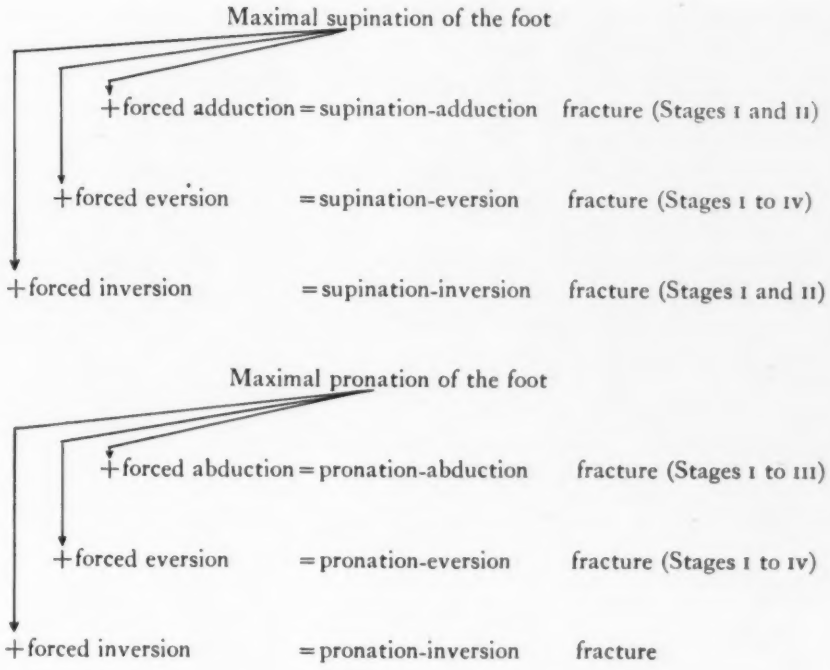


FIG. 14. A case of supination-adduction fracture, Stage II (see text and note the location and form of the fracture of the lateral malleolus).


Maximal supination of the foot
+forced adduction = supination-adduction fracture (Stages I and II)
+forced eversion = supination-eversion fracture (Stages I to IV)
+forced inversion = supination-inversion fracture (Stages I and II)
Maximal pronation of the foot
+forced abduction = pronation-abduction fracture (Stages I to III)
+forced eversion = pronation-eversion fracture (Stages I to IV)
+forced inversion = pronation-inversion fracture

recorded and the genetic roentgen diagnosis demonstrated for each type of fracture.

Supination-adduction fracture (Fig. 14).

Stage I: Transverse fracture of the lateral malleolus at varying height (as an exception just proximal to the malleolus) or detachment of the ligaments which are attached to the tip of the lateral malleolus (lig. calcaneo-fibulare and lig. talo-fibulare posterius) with small granular fragments from the tip of the lateral malleolus and (or) the lateral surface of the talus.

Stage II: Stage I+fracture of the medial malleolus.

Supination-eversion fracture (Fig. 15 and 16).

Stage I: Detachment (with small shell-shaped fragment) of lig. malleoli lateralis anterius (from the lateral malleolus or the tuberculum anterius tibiae or both).

Stage II: Stage I+oblique spiral fracture of the supramalleolar part of the fibula.

Stage III: Stage II+avulsion of small, medium-sized, or large fragment from the dorsal lip of the tibia (to which lig. malleoli lateralis posterius and lig. malleoli lateralis posterius distale are attached).

Stage IV: Stage III+fracture of the medial malleolus or detachment of the lig. deltoideum.

Supination-inversion lesion (Fig. 17, *A* and *B*).

Stage I: Rupture or detachment of ligamentum talo-fibulare anterius.

Stage II: Stage I+rupture of the ligament strengthening the lateral and plantar aspects of the calcaneo-cuboid articulation. A dorsoplantar roentgenogram of the mid foot (Fig. 18) can give the diagnosis by showing grain-sized osseous avulsions from the lateral contour of the cuboid and calcaneus and thus affords a diagnosis not only of the second lesion but also indirectly of the first.

Pronation-abduction fracture (Fig. 19 and 20).

Stage I: Fracture of the medial malleolus or detachment of the lig. deltoideum (with or without shell-shaped fragment).

Stage II: Stage I+detachment of lig. malleoli lateralis anterius with small fragment anterolaterally+detachment of lig. malleoli lateralis posterius and lig. malleoli lateralis posterius distale ("the transverse ligament") with small or large fragment torn from the dorsal lip of the tibia.

FIG. 15 FIG. 16

FIG. 15 and 16. Supination-eversion fracture, Stage IV (see text and note in the lateral view the location and form of the spiral oblique supramalleolar fracture of the fibula).

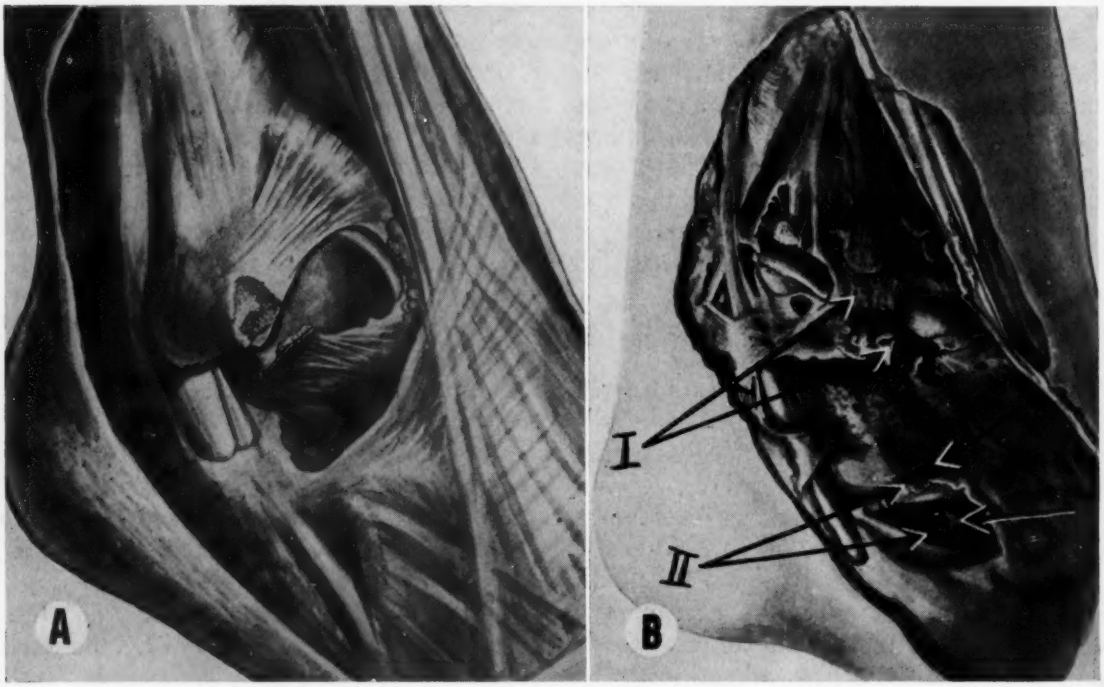


FIG. 17. (*A*) Drawing of supination-inversion lesion, Stage I. (*B*) Fracture of the same nature (detachment of ligamenta talo-fibulare (I) and calcaneo-cuboideum (II)).

Stage III: Stage II+oblique straight-lined fracture of the supramalleolar part of the fibula.

Pronation-eversion fracture (Fig. 21 and 22).

Stage I: See pronation-abduction fracture, Stage I.

Stage II: Stage I+detachment of the lig. malleoli lateralis anterius and the ventral part of the lig. interosseum tibio-fibulare with small anterolateral fragment from tibia.

Stage III: Stage II+spiral fracture of the fibula 7–8 cm. or more proximal to the tip of the lateral malleolus.

Stage IV: Stage III+detachment of the lig. malleoli lateralis posterius and lig. malleoli lateralis posterius distale with a small or large fragment torn off from the dorsal lip of the tibia.

Pronation-inversion fracture.

This is a fracture of the crural bones with the spiral fracture lines running in proximo-medial direction.

The ratio of incidence of various types of fractures from a clinical material is shown in Table I.

FIG. 18. Clinical case with small fragments at the calcaneo-cuboid articulation (supination-inversion lesion II).

"Ligamentous" Ankle Fractures

In the literature it is often still deplored that sprain and ligamentous rupture involving the ankle region are dark points,

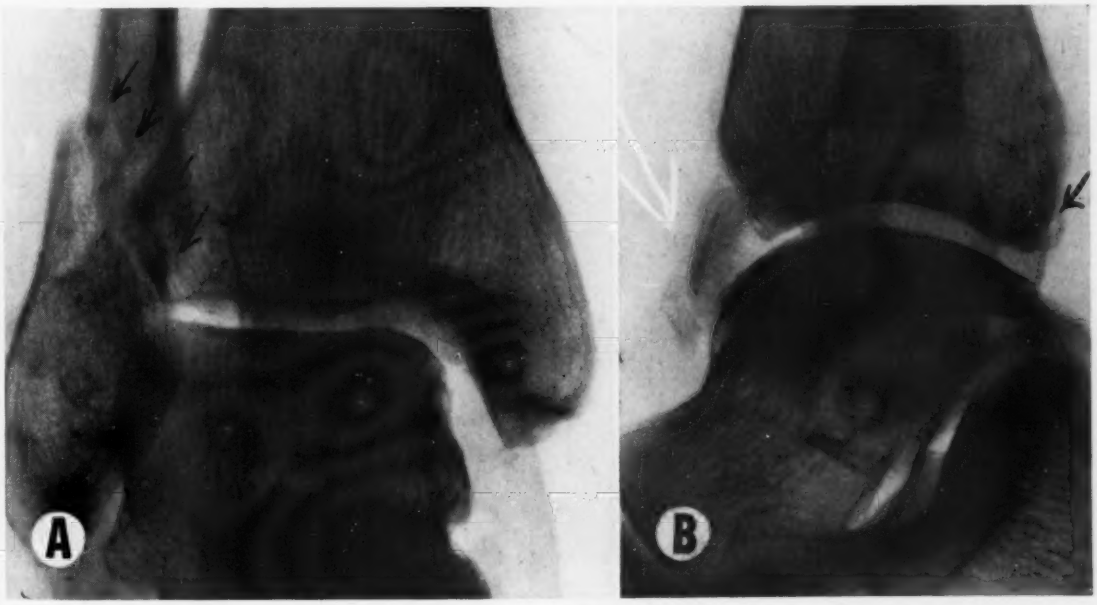


FIG. 19, (*A*) and (*B*). Pronation-abduction fracture, Stage III (see text and note, in the anteroposterior view, the oblique transverse fracture of the supramalleolar part of fibula; very indistinctly seen in the lateral view).

FIG. 20. Another case of pronation-abduction fracture, Stage III (fracture of the medial malleolus).

and that these affections often cause diagnostic and therapeutic difficulties and result in disability.

In order, if possible, to find the underlying cause of this difficulty a material consisting of all ambulant and hospitalized patients who were referred to roentgen examination in the Central Hospital, Randers, during the twelve months from July 1, 1947, to June 30, 1948, for recent lesions of the ankle region was made the object of a closer investigation.

It is emphasized that detachment of medial or lateral ligaments of the ankle is often an equivalent to a fracture of the medial or lateral malleolus.

In all the four types of ankle fracture, Stage I is, or may be, a ligamentous detachment, *i.e.*, a "ligamentous" ankle fracture.

If there is a lesion at Stage I, and this lesion is a ligamentous detachment, it is not always possible to demonstrate it by ordinary roentgen studies; but nevertheless it is easy to obtain a precise and exact diagnosis by a special roentgen examina-

FIG. 21

FIG. 22

FIG. 21 and 22. Pronation-eversion fracture, Stage IV (see text and note the location of the fibula above the ligamentum interosseum tibio-fibulare). (The only type of ankle fracture with tear of the ligamentum interosseum tibio-fibulare.)

tion. Its accuracy will appear evident from the material. In the following, each individual type of ankle fracture will be dealt with, particularly the varieties with ligamentous detachments only.

Supination-Adduction Fracture I, i.e., transverse fracture at a varying height of the lateral malleolus or rupture or detachment of ligamentum calcaneo-fibulare and ligamentum talo-fibulare posterius. Detachment occurs at the attachments of these ligaments either at the tip of the lateral malleolus or on the calcaneus and talus.

These ligamentous detachments are demonstrable in an ordinary roentgenogram only when a bone splinter large enough to be visible on the film has been torn off. If this is not the case, and a ligamentous fracture is suspected, a special roentgen examination must be made in the frontal plane, while the hind foot is adducted. The distal part of the leg is fixed with one hand while the other grasps around the foot at the calcaneus from the plantar aspect and moves it medially—adduction. This is done with a vigorous and persistent adduction pull and may be accomplished without anesthesia. In this way a distinct varus position of the talus in the "malleolar fork" (tibiofibular mortise) occurs, and the distance between the talus and the tip of the lateral malleolus is increased, indicating ligamentous detachment laterally (Fig. 23 and 24).

Fig. 23. Ligamentous detachment laterally with talus in varus position and increase of the distance between the tip of the lateral malleolus and the talus under adduction of the hind foot (supination-adduction fracture, Stage 1—ligamentous).

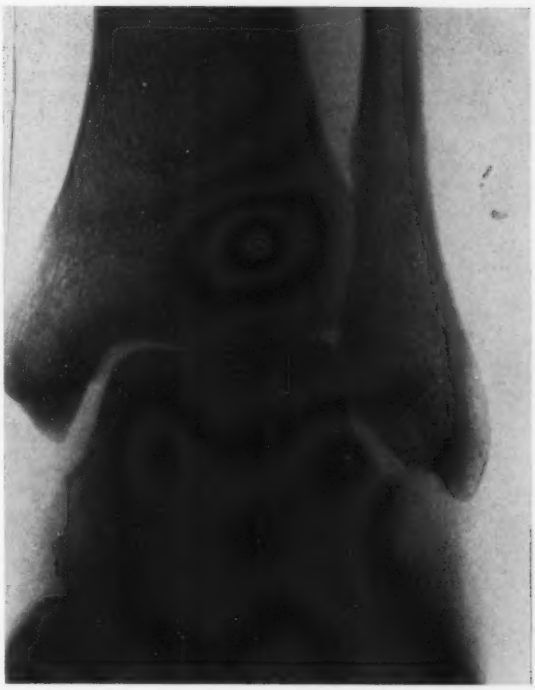


Fig. 24. Roentgenogram of the same ankle without adduction.

By roentgen examination under ordinary supination of the foot, which is sometimes recommended, the varus position of the talus in the malleolar fork will not occur unless the supination is very vigorous, and a simultaneous inversion (inward rotation) of the foot is carried out, by which the hind foot is adducted to a certain extent. This maneuver will cause a strong muscular fixation and intense pain owing to tightening of the tendons running behind and distal to the lateral malleolus. If the hind foot

FIG. 25. Detachment of the ligamentum malleoli lateralis anterius with a bony shell-shaped fragment from tuberculum anterius tibiae (supination-eversion fracture, Stage I—ligamentous).

is adducted as described in the preceding paragraph, it is possible to avoid these difficulties which may to a smaller or greater extent disturb the roentgen examination and lead to an erroneous result. Considering that ligamentous detachment takes place along the entire lateral surface of the talus, and that there is often a simultaneous rupture of the joint capsule of the posterior talocalcanean articulation strengthened by a ligament laterally, it will be realized that the affection is a serious one.

The lesion is very frequent, but so far it is rarely diagnosed primarily, as there is no or only slight changes of the bones in the roentgenogram, and since roentgenograms taken under adduction are not commonly used. We have often had the experience that the lesion is not diagnosed primarily.

FIG. 26. Ligamentous detachment medially with increased width of the articular space between the medial malleolus and the talus under abduction of the hind foot (pronation-abduction fracture, Stage I—ligamentous).

FIG. 27. Roentgenogram of the same ankle without adduction.

Supination-Eversion Fracture I, i.e., detachment of ligamentum malleoli lateralis anterius, is not roentgenologically demonstrable when it occurs as an isolated lesion, except when a splinter of bone large enough to be seen in the lateral view (Fig. 25) has been torn off, but this is usually not the case.

In the presence of a swelling corresponding to the ligament a very distinct tenderness corresponding to the ligamentous attachment on the tuberculum anterius tibiae and on the proximal part of the anterior margin of the lateral malleolus will give the diagnosis.

Pronation-Abduction Fracture I, i.e., fracture of the medial malleolus or detachment of the deltoid ligament. If the ligament has been detached with a splinter of bone not large enough to be demonstrated roentgenographically, nothing abnormal will be seen in the roentgenogram of the ankle region since the talus generally occupies its normal position in the malleolar fork. By a special exposure in the frontal plane under abduction of the hind foot (the distal part of the crus is fixed, and the calcaneus is grasped and moved laterally), the talus will adopt a valgus position in the "malleolar fork," and the articular space between the medial malleolus and talus is widened, indicating a ligamentous lesion (Fig. 26 and 27).

Fig. 29. Roentgenogram of the same ankle without eversion.

Fig. 28. Ligamentous detachment medially and in the syndesmosis (ligamenta malleoli lateralis anterius and interosseum tibio-fibulare) with increased width of the syndesmotic space and of the articular space between the medial malleolus and the talus, the latter being in valgus position due to eversion (outward rotation) of the foot (pronation-eversion fracture, Stage II—ligamentous).

Pronation-Eversion Fracture II, i.e., lesion as in pronation-abduction fracture I+detachment of ligamentum malleoli lateralis and ligamentum interosseum tibio-fibulare. (Strictly speaking it ought to be designated as Stage I, since I of pronation-eversion fracture corresponds to pronation-abduction fracture I, and since it is actually Stage II—the lesion of the ligaments of the syndesmosis—which denotes and is the commencement of the pronation-eversion type of fracture.) If in this type there is no fracture of the medial malleolus, but detachment of the deltoid ligament, it will generally be impossible to demonstrate it roentgenologically as the position of the talus in the malleolar fork is completely normal, and the syndesmotic space presents natural conditions. If, on the other hand, a roentgenogram is taken in the frontal plane while the foot is everted (rotated outward), it will be possible to

TABLE I

	1942	1948
Supination-Adduction Fracture		
Stage I (ligamentous)		19
Stage I	25	10
Stage II	23	9
	48 = 15.5%	38 = 35.8%
Supination-Eversion Fracture		
Stage I	8	4
Stage II	72	14
Stage III	48	7
Stage IV	84	10
	212 = 68.6%	35 = 33%
Pronation-Abduction Fracture		
Stage I (ligamentous)		5
Stage I	6	4
Stage II	9	4
Stage III	3	5
	18 = 6%	18 = 17%
Pronation-Eversion Fracture		
Stage II (ligamentous)		7
Stage II	4	2
Stage III	4	4
Stage IV	18	2
	26 = 8.3%	15 = 14%

demonstrate valgus of the talus in the "malleolar fork," increase of width of the interspace between the talus and the medial malleolus, and of the syndesmotic space (Fig. 28 and 29).

In Table I the ratio of incidence of the four types of ankle fracture of the material from 1942 will be found.

For the purpose of comparison the ratio of incidence of the types of fracture of the material from July 1, 1947, to June 30, 1948, is also cited in the table.

The material from 1942 originates from a purely urban population (Copenhagen). In the material from 1948 a considerable portion of the patients belongs to the rural population.

In an urban population the ratio of incidence of supination-eversion fractures is greater than in a rural population, which accounts for some of the difference in the ratio of incidence of the two materials. But the most essential part of the difference is, however, due to the large number of "ligamentous" ankle fractures which were demonstrated in the material from 1948. The number of these fractures (31) is relatively large, particularly in the supination-adduction group, but it is also considerable in the pronation-abduction and pronation-eversion groups.

Thus the investigations presented here seem to show that if a special roentgen examination is omitted in case of the presence of clinical symptoms of a lesion of the ankle joint region, approximately 30 per cent of serious lesions, *i.e.*, the "ligamentous" ankle fractures, will not be diagnosed primarily.

As isolated lesions of ankle ligaments are equivalent to ankle fractures with regard to genesis and tendency of dislocation, the treatment should be as in case of ankle fractures.

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LETTERER-SIWE'S DISEASE

PROBLEMS IN DIAGNOSIS AND TREATMENT*

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LETTERER-SIWE'S disease (nonlipoid reticuloendotheliosis) is a rare, usually fatal illness, occurring most frequently in children under two years of age, and characterized clinically by a hemorrhagic maculopapular rash, hepatomegaly, splenomegaly, lymphadenopathy and anemia. The distinctive pathologic feature is a nodular or diffuse proliferation of histiocytes in the skin, liver, spleen, lymph nodes and sometimes the skeleton. Several years ago a hypothesis was advanced, linking this disorder with Hand-Schüller-Christian disease and eosinophilic granuloma of bone. Since then several reviews[2,6,7] have been published supporting the thesis that these three diseases represent different clinical expressions of a basic disorder of the reticuloendothelial system. Also recorded are other views contradicting such a relationship. It is not the purpose of this report to submit evidence to support or refute either hypothesis.

The principal intent of this paper is to emphasize certain pulmonary roentgen findings since the other authors have emphasized skin lesions, bone lesions, and hematological findings, and to record the results of various types of therapy in the effort to control the disease. The report is based on 4 cases of typical Letterer-Siwe's disease which have been observed at the Children's Hospital in Cincinnati in the past seven years. The fifth case was observed for only a brief period and the patient died elsewhere. Although the latter case is atypical, it is included because of the interesting progression of lesions.

REPORT OF CASES

CASE 1. An eight day old, white female infant, was admitted to the Children's Hospital on October 24, 1945, with a generalized, crusted, maculopapular rash. At birth, hemorrhagic spots had been noted over the entire body. These became pustular, but after treatment with a salve for several days the lesions dried and scaled. On the day prior to admission the baby became very restless and irritable and had an axillary temperature of 102°F.

Physical examination showed a well developed, well nourished, small infant, not acutely ill. The entire body was covered with a generalized, reddish, discrete, crusted, maculopapular eruption (Fig. 1). The individual lesions varied from 1 to 5 mm. in diameter, and bled easily. Numerous lesions were present on the palms but very few were on the soles. The scalp was extensively involved. Large mucoid patches covered the pharynx and tonsils. The superficial lymph nodes were enlarged but the liver and spleen were not palpable. The initial clinical impression was congenital syphilis, in spite of a negative family history.

Laboratory Findings. The red blood cells numbered 4.9 million and the hemoglobin was 14.1 grams. The white blood cell count was 8,600. Serological tests for syphilis were negative. The urine contained a few white blood cells. Cephalin flocculation test was 1 plus.

Roentgen Findings (Fig. 2). Roentgenographic examination of the chest revealed a finely nodular infiltrate scattered throughoout both lung fields with confluence of the lesions on the right side. The heart and bony framework were normal.

Course. On the fourth hospital day, treatment with intramuscular penicillin was begun, and penicillin ointment was applied to the rash. The crusting lesions cleared but the macular lesions persisted. By the fifteenth day the patient improved sufficiently to warrant discontinuance of the intramuscular penicillin.

On the twentieth day the child's condition suddenly became worse, and within several days she lost weight and became very cachectic.

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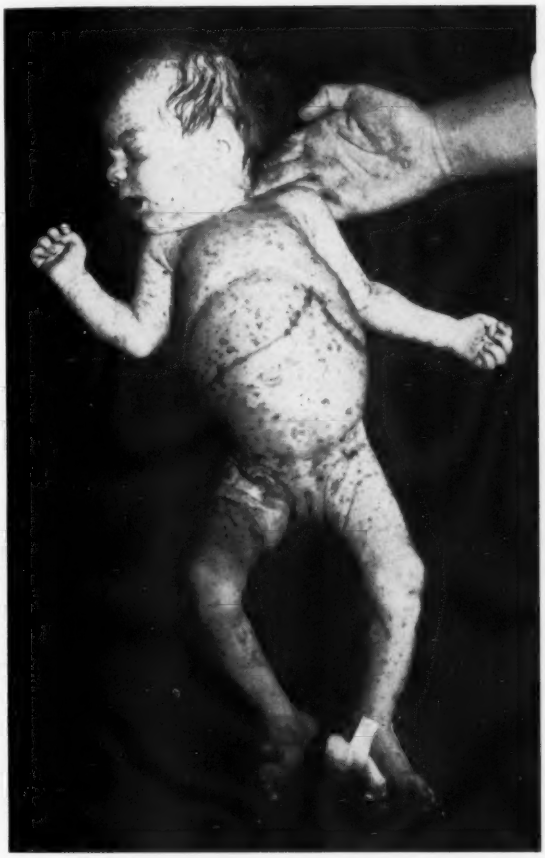

Fig. 1. Case 1. Eight day old white female infant. Note characteristic generalized hemorrhagic maculopapular rash.

The eruption became hemorrhagic and the liver and spleen enlarged rapidly. The hemoglobin dropped to 9.1 grams and the red blood cell count to 3.3 million. Biopsy of a cutaneous lesion and an inguinal lymph node established the diagnosis of Letterer-Siwe's disease. A blood culture at this time was positive for a hemolytic *Staphylococcus aureus*, coagulase positive. Blood transfusions and additional penicillin therapy failed to halt a rapidly retrogressive course. The patient died November 22, 1945, thirty-seven days after admission.

Necropsy. The skin was covered with innumerable 2 to 4 mm. hemorrhagic papular lesions, many of which were ulcerated and crusted. These lesions were generalized but were most numerous over the face, neck, thorax and abdomen. The thymus was small and was spotted with many 1 to 4 mm. yellow nodules. The lungs were heavy and the pulmonary tissue was subcrepitant, dry and brownish-red. Many consolidated areas of varying sizes were present in all lobes, particularly the lower lobes. In addition, the pulmonary substance was peppered throughout with miliary light gray nodules. The bronchial mucosa was slightly reddened and covered with a tan mucoid secretion. The heart was normal. The liver (185 grams) was one and a half times the normal weight and was speckled with many light gray nodules. The spleen (85 grams) was four times the normal weight. The pulp was firm and dark red, and no trabecular or follicular markings were visible. There was generalized enlargement of the lymph nodes. The largest nodes were located about the head of the pancreas and hilus of the liver, and were hemorrhagic. A small amount of sterile mucopurulent exudate was present in the middle ear. The skeletal system was normal.

Case II. An eleven week old, breast fed, white male infant was admitted to the Children's Hospital on April 27, 1946, with a history of grunting respiration and a rash since birth. The eruption involved the entire body and was characterized by scaling and the formation of papules which gradually became hemorrhagic. Weight gain had been good. However, one week before admission the baby became somewhat pale and developed a cold accompanied by a severe cough and exaggeration of the

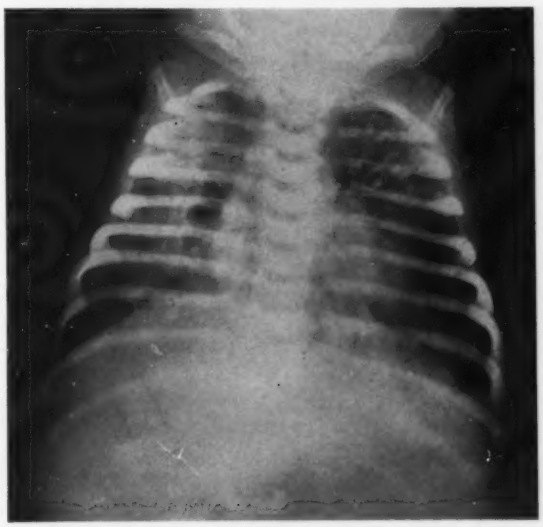

Fig. 2. Case 1. There is finely nodular infiltrate in both lung fields, with confluence of the infiltrate on the right side.

grunting respirations. He was treated with penicillin without improvement. A few days before admission he was examined at another hospital, and a diagnosis of an intrathoracic tumor was made.

Physical examination showed an acutely ill, drowsy, pale infant, breathing with difficulty. The rectal temperature was 103°F. The skin was covered with multiple, small, discrete, papular, purpuric lesions. Several similar lesions were present in the mouth. The right anterior cervical lymph nodes and the liver and spleen were enlarged. Respirations were accelerated and expiratory grunting was pronounced.

Laboratory Findings. The red blood cells numbered 2.6 million and hemoglobin was 6.6 grams. The leukocyte count was 14,000, with 79 per cent neutrophils, 2 per cent eosinophils, 10 per cent lymphocytes and 9 per cent monocytes. Blood cultures and serologic tests for syphilis were negative. Total serum proteins were 3.9 grams with 2.3 grams albumin and 1.6 grams globulin; cephalin flocculation test was 3 plus. Tuberculin and histoplasmin skin tests were negative. Urinalysis showed traces of albumin, sugar and acetone; 20 leukocytes and a few red blood cells per high power field.

Roentgen Findings (Fig. 3). Roentgenoscopic and roentgenographic examination of the chest showed marked enlargement of the thymus, a normal cardiac configuration and a small amount of finely nodular infiltrate in the right lower lung field. The skull and long bones were normal.

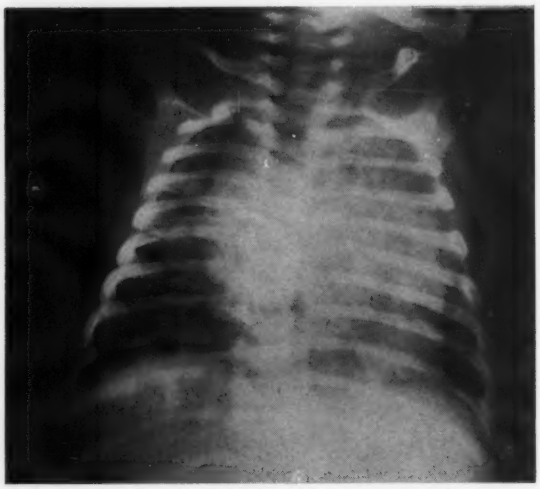

FIG. 3. Case II. Eleven week old white male infant. There is marked enlargement of the thymus, with a small amount of finely nodular infiltrate in the lower lung fields.

Course. The child was treated with blood transfusions and sulfadiazine without obvious benefit. His temperature spiked daily to 103°F., and on the fifth day he developed respiratory distress and died.

Necropsy. The skin was covered with innumerable small, hemorrhagic macules and papules which were most numerous over the scalp and back, and least numerous over the extremities. A small hemorrhagic lesion was present on the upper gum.

The thymus was greatly enlarged measuring 5 by 7.5 by 8 cm. It filled the anterior mediastinum, displaced the heart posteriorly, pushed the lungs laterally and extended almost to the left lateral chest wall. The thymic tissue was moderately soft, dark red and hemorrhagic, and was speckled with yellow and gray miliary nodules. The lungs were heavy and all lobes contained confluent areas of pneumonic consolidation which were speckled with miliary gray nodules and an occasional larger soft yellow nodule. Emphysematous blebs were present in the anterior positions of both upper lobes and the right middle lobe.

The liver (415 grams) was about two and a half times its normal weight. It was peppered with pale gray nodules, 1–5 mm. in diameter, and irregularly spotted in the subcapsular zone by a few larger masses of rubbery, yellowish-gray tissue. The spleen (52 grams) was about three times its normal weight. The pulp was dark red, soft and friable, and the gray follicular markings were prominent. The abdominal and retroperitoneal lymph nodes were greatly enlarged and consisted of soft, grayish-red tissue, speckled with small hemorrhages. The bronchial and cervical lymph nodes were moderately enlarged. The bone marrow was normal.

Comment. Cases I and II demonstrate the severe fulminating course of Letterer-Siwe's disease in the newborn group. There was rapid development of the skin rash, anemia, extensive infiltration of the lungs, liver and spleen followed by the development of overwhelming infection and death.

CASE III. This white male infant, aged six and one-half months, was first admitted to Children's Hospital on June 16, 1947, because

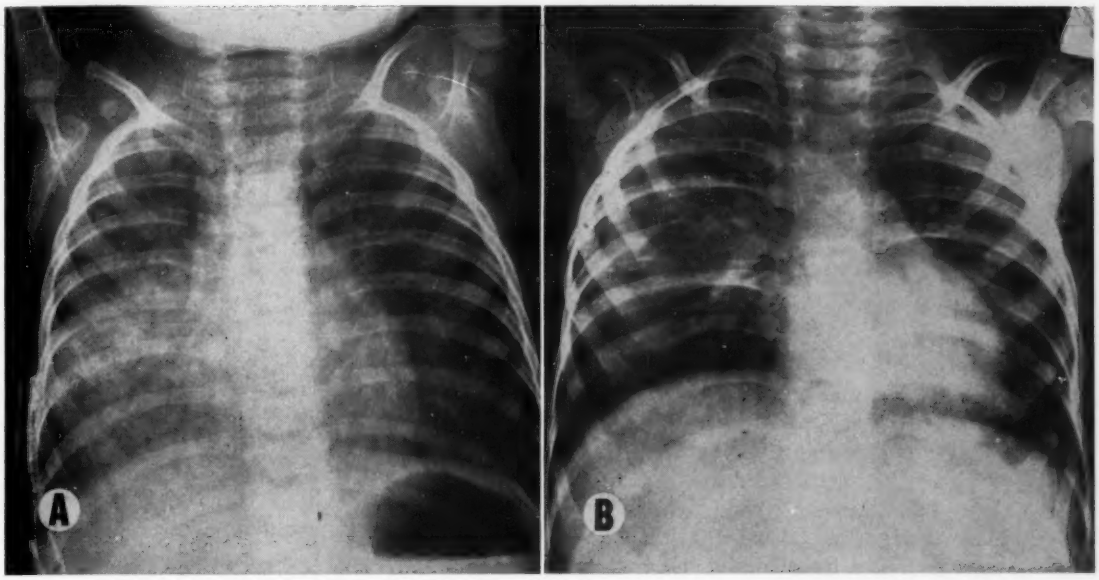

FIG. 4. Case III. Six and a half month old white male infant. (*A*) Chest roentgenogram on admission shows finely nodular infiltrate present diffusely throughout both lung fields, and somewhat denser in the right middle lobe. (*B*) Chest roentgenogram after 1,300 r. There was marked clearing of the infiltrate, but destruction of the 6th right and 7th left posterior ribs developed.

of a persistent skin eruption and failure to gain weight. The rash, first observed at ten days of age over the lower abdomen, had gradually spread to involve the entire body and scalp. The initial lesions were 2 to 3 mm. white or gray macules which later became hemorrhagic. Ammoniated mercury and gentian violet, applied topically, were without benefit, but after three roentgen treatments to the trunk, a slight fading of the eruption was noted. Oral lesions were first observed at about four months. Thereafter the child failed to gain weight and his general condition became worse. Two weeks prior to admission he was admitted to another hospital and was treated with penicillin, with no benefit. Family history revealed that a second cousin, aged three months, died of sympathicoblastoma.

Physical examination on admission showed an undernourished, poorly developed, irritable baby weighing 12 lb. 11 oz. with a generalized eruption of macules, petechiae, ecchymoses and crusted papules. The scalp was covered with reddish crusts and scales. The mucosa of the mouth was edematous and a thick yellow-white pseudomembrane coated the gums. The ear canals were filled with exudate. The edge of the liver was 3 cm. below the right costal margin and the tip of the spleen was felt 1 cm. below the left costal margin. The preauricular and postauricular, cervical, axillary, and inguinal lymph nodes were readily palpable.

Laboratory Findings. The red blood cells numbered 4.2 million and the hemoglobin was 11 grams. The white blood cell count was 9,000, with 57 per cent neutrophils, 5 per cent eosinophils, 30 per cent lymphocytes and 8 per cent monocytes. Serologic test for syphilis was negative. The urine was normal. Bacteriological studies of the throat and each ear were noncontributory. Tuberculin and histoplasmic skin tests were negative. A biopsy of skin on June 21, 1947, showed histiocytic proliferation characteristic of Letterer-Siwe's disease.

Roentgen Findings (Fig. 4). Finely nodular infiltrate was scattered diffusely throughout both lung fields and was somewhat denser in the right middle lobe. The skull and long bones on admission were normal. Re-examination of the long bones at intervals during the succeeding months revealed gradual demineralization with decrease in cortical thickness and widening of the medullary spaces.

Course. At first the child was treated with streptomycin, sulfamerazine, and penicillin, but there was no improvement with this therapy.

Between June 27 and December 17 the child

received roentgen therapy. Factors were 200 kv. (peak), 20 ma. 50 cm. focus skin distance, filtration 0.5 mm. copper plus 1 mm. aluminum. All doses were measured in air. Field sizes varied between 100 and 150 sq. cm. Various large areas received 50 r per treatment. During the life of the infant, the head and neck were given 825 r, the chest area received 1,300 r, and the abdomen received 550 r anteriorly and 200 r posteriorly. Several additional smaller areas were treated, and during the entire period the child was given a total of 3,475 r. The oral lesions were treated on three different occasions, and after each there was marked improvement. As a result, the child was able to eat better and showed temporary improvement in his general condition. There also was definite fading of the skin rash following irradiation. A skin biopsy at this time (Fig. 7) showed healing of older lesions but tiny fresh histiocytic infiltrations were present in adjacent areas. Roentgenographic examination of the chest showed partial clearing of the pulmonary lesions following roentgen therapy, but at no time was this improvement striking.

The patient was finally discharged on November 3, 1947, somewhat improved, but was readmitted twelve days later in slightly worse condition. At this time he was thinner and weaker, and moved but little. Three days before, there was a florid outbreak of purpuric lesions on the trunk and extremities. The oral mucous membrane was reddened and necrotic, and covered by a yellowish-green pseudomembrane. Many of the erupted teeth had fallen out. The lymph nodes of the neck were palpable and discrete. The liver was enlarged but the spleen was not palpable.

The red blood cell count was 5.1 million and the hemoglobin was 12.4 grams. The white blood cell count was 6,500. A roentgenogram of the chest showed some clearing of the pulmonary infiltrate. However, beginning destruction of the vertebral end of the right sixth rib was noted.

On this admission, a course of nitrogen mustard was instituted, with 0.6 mg. of methyl bis-beta chlorethylamine hydrochloride being administered intravenously daily for four days. The fever which was present on entry subsided but the skin lesions became worse. He developed persistent leukopenia, with the count ranging from 4,000 to 1,000. The red blood cell count and hemoglobin also fell to 3.2 million and 9 grams respectively, necessitating several small blood transfusions. The child was then given a second course of nitrogen mustard two weeks apart after the completion of the first. Four doses totaling 2.8 mg. were administered intravenously. No clinical improvement was noted. The patient's general condition remained poor, and he was discharged unimproved on December 23, 1947.

Three weeks later he was readmitted for symptomatic treatment. All superficial lymph nodes had increased in size; the liver was hard; and the rash and oral lesions had become worse. The child became more cachectic and death occurred on January 27, 1948, at the age of fourteen months—225 days after the first admission.

Necropsy. The entire skin was studded with small, bright red macules and papules of varying sizes, many of which were ulcerated or crusted. Petechiae were present on the lower extremities. The gums were dark gray and black, necrotic and ulcerated. The teeth, which remained, were loose. The thymus was not enlarged. The lungs were heavy and subcrepitant, and contained a diffuse gray infiltrate in the right upper lobe and both lower lobes, and nodular areas of consolidation in the left upper lobe anteriorly and in the right middle lobe. The liver, which was slightly smaller than normal, was very firm and mottled with tiny gray spots and streaks. The spleen was of normal size and was composed of a firm, dark red pulp with indistinct follicular markings. The superficial and internal lymph nodes were enlarged, and an area of suppuration was present in one of the nodes on the right axilla. Adjacent to the vertebra there was 1.5 by 4 cm. fusiform enlargement of the sixth rib on the right, and the seventh rib on the left, replaced by a firm, rubbery, dark red tissue, mottled with gray and yellow areas. The adjacent soft tissue was not involved. The skeletal system was otherwise normal.

Case IV. This white male was first admitted to Children's Hospital on April 30, 1949, at the age of one and one-half years. His illness began in January, 1949, with a respiratory infection. This had recurred and became more severe in the succeeding months with increasing cough, tachypnea, and mild anorexia. During this period a rash was noted on the scalp, and this gradually became worse.

Physical examination showed a pale, poorly developed, poorly nourished, chronically ill

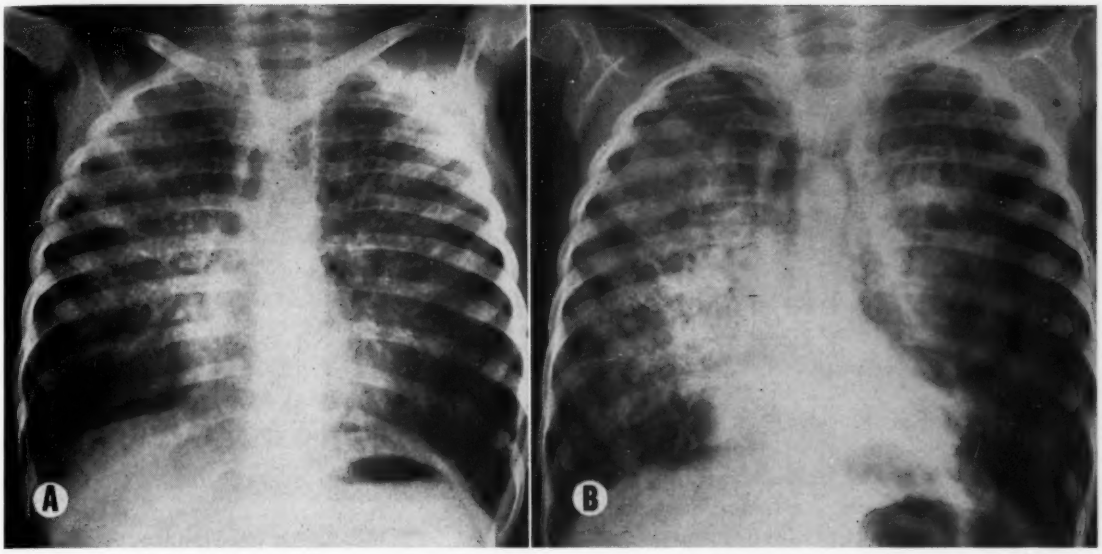

Fig. 5. Case iv. One and a half year old white male. (*A*) Chest roentgenogram April 2, 1949, shows finely nodular infiltrate disseminated throughout both lung fields, with marked bilateral pulmonary emphysema. (*B*) Chest roentgenogram following bilateral spontaneous pneumothorax.

child. The rectal temperature was 99.2°F. The superficial lymph nodes were slightly enlarged and an impetiginous rash was present over the scalp, trunk and pubis. A purulent exudate drained from the left ear. The chest was hyperresonant and fine crepitant rales were heard bilaterally.

Laboratory Findings. The red blood cell count was 5.5 million and the hemoglobin was 13.5 grams. The white blood cell count was 13,200, with 40 per cent neutrophils, 4 per cent eosinophils, 47 per cent lymphocytes and 9 per cent monocytes. A serologic test for syphilis was negative. The urine was normal. Tuberculin and histoplasmin skin tests were negative. Smears of the bone marrow were normal.

Roentgen Findings (Fig. 5). Chest roentgenograms showed a finely nodular infiltrate disseminated throughout both lung fields, and marked bilateral pulmonary emphysema. The pleura was slightly thickened bilaterally. The trachea was displaced to the right. Survey of the long bones disclosed moderate demineralization.

Course. The original clinical impression was cystic fibrosis of the pancreas. The first three weeks of the patient's hospital course were marked with episodes of cyanosis and fever, and an extension of the rash. The liver and spleen gradually enlarged. Because of the respiratory difficulty the child was placed in an oxygen tent and given intramuscular and aerosol penicillin. A biopsy of a cutaneous lesion at this time showed a histologic picture compatible with Letterer-Siwe's disease.

On May 26 radiation therapy was begun. Factors were 200 kv. (peak), 20 ma., filtration 0.44 mm. Sn, 0.25 mm. Cu, 1 mm. Al. From May 26 until July 29 the child received 800 r to the anterior chest, 850 r to the posterior chest and 800 r to the anterior abdomen over the liver and spleen. Following these treatments the general condition of the child improved. The skin lesions over the body cleared. The liver and spleen decreased in size. No effort was made to treat the scalp.

On October 6, 1949, the patient was readmitted. He was markedly cyanotic and in acute respiratory distress following the sudden onset of a left tension pneumothorax. The general condition had again deteriorated. Scattered maculopapular erythematous lesions were present over the trunk, and a desquamating scaly eruption involved the scalp. The lymph nodes were enlarged. The edge of the liver was 3 cm. below the costal margin, and the tip of the spleen was palpable. Roentgenograms of the chest showed, in addition to the diffuse nodular infiltrate, a left pneumothorax with some mediastinal shift to the right. The long bones again showed diffuse osteoporosis.

The left lung expanded gradually and the general condition of the child improved rapidly after the first week of hospitalization. During

this admission the patient was maintained on aureomycin.

During the next four months the patient showed satisfactory progress. Occasional episodes of coughing and vomiting occurred but these promptly improved with aureomycin. He was discharged on October 10, 1949.

On March 29, 1950, the child was hospitalized for a third time following another sudden attack of severe respiratory difficulty and marked cyanosis. Chest roentgenograms showed a left tension pneumothorax with mediastinal shift to the right. The child was placed in oxygen, and penicillin and aureomycin was administered. On March 31 a closed thoracotomy with suction was performed and continued for thirty-two days. The patient remained in critical condition and oxygen was required for twenty-nine days. He was finally discharged on the forty-third hospital day.

Subsequent examinations in 1951 and 1952 showed a progressive gain in weight. The chest was normal on physical examination, although there was no change in the infiltrate in the chest roentgenograms. Some scaling persisted in the scalp but lesions were not present elsewhere on the skin.

Comment. It might be noted here that Case III demonstrates a somewhat more chronic course in this disease. The onset of the disease was early but symptoms developed more gradually. The lesions were radiosensitive, but it was not possible to effect complete healing of the lesions with radiation therapy by giving multiple small doses over the entire body. This fact was demonstrated by the skin biopsies which showed healing of some lesions but the appearance of fresh nodules in adjacent areas. It was hoped that by giving multiple small doses the histiocytic invasion could be slowed, and the child might enter a less severe phase of this syndrome as is seen in Hand-Schüller-Christian disease. Penicillin therapy probably helped to combat infection in part, but if some of the newer wide range antibiotics had been available, the clinical response might have been more nearly similar to that of Case IV.

In Case IV the onset was even later, at about one year. In spite of moderate radiation therapy, aureomycin, penicillin, and vigorous supportive measures, at no time has the patient been free from evidence of active Letterer-Siwe's disease. He has, however, been able to combat several episodes of severe infection and pneumothorax very well. Without the excellent medical and surgical care given by our resident staff it is certain that he would not have responded as well as he did up to the present time.

Case V. This white female, aged one year, was admitted to Children's Hospital on June 20, 1944. On May 29 she fell, striking the left side of the head. Two days later a large fluctuant, indurated mass appeared behind the left ear. Some enlargement over the right mastoid was noted. She was admitted to another hospital where the left ear drum was incised and pus obtained. Incision of the left postauricular mass yielded a grayish, gelatinous material which on histologic examination was interpreted as eosinophilic granuloma of bone. Two weeks later the mass was partially excised, and the pathologic diagnosis of granuloma, consistent with Hand-Schüller-Christian disease was made. The patient was then referred to the Children's Hospital for further observation. Past history was normal. Family history revealed a first cousin, a male, aged twenty-three, who had diabetes insipidus and bone lesions described as osteitis fibrosa cystica.

Physical examination showed a well developed and well nourished infant in no distress. The skin was normal. The left ear was displaced laterally and down by a large, soft, egg-sized mass. The left external auditory meatus was stenotic and filled with foul pus. A smaller, softer mass, about 2 cm. in diameter, lay over the right mastoid. The liver and spleen were not enlarged.

Laboratory Findings. Hematologic examination revealed a red blood cell count of 4.4 million, hemoglobin of 9.8 grams and leukocyte count of 5,750, with 38 per cent neutrophils, 7 per cent eosinophils, 54 per cent lymphocytes and 1 per cent monocytes. The urine was normal.

Roentgen Findings. Roentgenologic study of the skull revealed sharply demarcated, rounded areas of destruction in both the right and left mastoid bones. The long bones were normal.

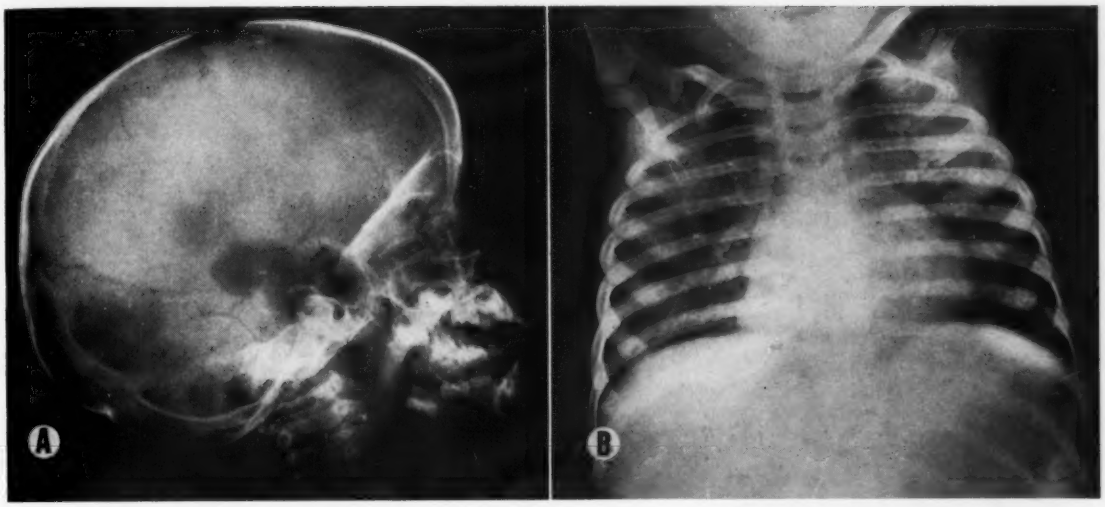

Fig. 6. Case v. One and a half year old white female. (*A*) Skull roentgenogram showing characteristic extensive destruction of the mastoid, temporal bone and sphenoid bones. These lesions are characteristic of Hand-Schüller-Christian disease. (*B*) Chest roentgenogram showing aerated lungs, diffusely spotted with punctate areas of increased density, about each of which there was a small zone of emphysema. (Roentgenogram courtesy of Dr. E. B. D. Neuhauser, Children's Hospital, Boston.)

Course. The child was discharged after two days, and was readmitted four months later. In the interval she had received radiation therapy to the mastoid lesions and had developed diabetes insipidus which was controlled with pituitrin in oil. The child had grown normally. There was a doughy swelling in the the right mastoid area, and exudate was present in the right otic canal. Roentgenograms of the skull disclosed progression of the osteolytic lesions in both mastoid areas. Roentgenograms of the chest and abdomen were normal.

At about one and one-half years of age, fever developed and sinuses behind both ears began draining. A rash appeared on the face. Penicillin was administered during the last six months of life. Three months before death a a course of radiation therapy was given

In May, 1945, the patient was admitted to the Children's Hospital, Boston, Mass. She was an extremely pale child with a draining lesion behind the left ear. A rash, with petechial and purpuric papules, involved the entire body. The lungs were hyperresonant and emphysematous, and numerous rhonchi were audible. The superficial lymph nodes, spleen and liver were enlarged.

The red blood cells numbered 1.9 million with 5.2 grams of hemoglobin. The white blood cell count was 4,700 and the platelet count was 14,000. Albuminuria was present.

Roentgen Findings. (By courtesy of Dr. E. B. D. Neuhauser.) There was extensive destruction of each mastoid, the sella turcica and sphenoid. The margins of these lesions were sharp and nonreactive and characteristic of the lesions of Hand-Schüller-Christian disease. The spine and long bones were normal. A roentgenogram of the abdomen showed enlargement of the liver and spleen. The chest roentgenogram revealed well aerated lungs, diffusely spotted with punctate areas of increased density about each of which was a small zone of emphysema. A rounded shadow of increased density was present in the right cardiophrenic angle. The heart was slightly enlarged.

In spite of multiple transfusions, penicillin and radiation therapy, the patient's condition deteriorated. She began to vomit, became restless and apprehensive, and developed respiratory difficulty. A septic fever, spiking to 105°F. developed. She died on May 14, 1945, one year after onset of her illness.

Necropsy. (By courtesy of Dr. S. T. Farber.) There were petechiae over the entire body and a papular rash over the thorax, face and scalp. The lungs contained multiple small green nodules which, microscopically, were areas of infiltration with mononuclear cells filled with scharlach R positive material. A septic pulmonary infarct and areas of interstitial pneumonia and bronchopneumonia also were pres-

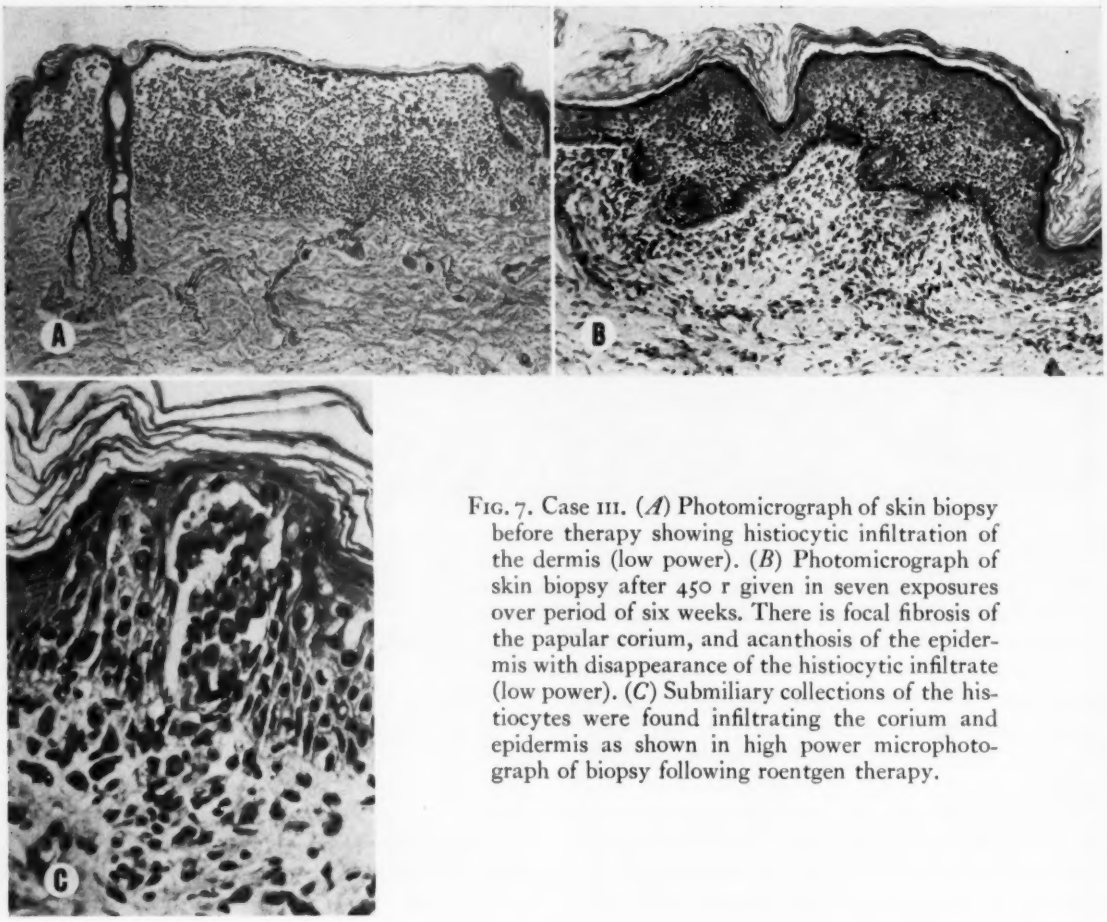

FIG. 7. Case III. (*A*) Photomicrograph of skin biopsy before therapy showing histiocytic infiltration of the dermis (low power). (*B*) Photomicrograph of skin biopsy after 450 r given in seven exposures over period of six weeks. There is focal fibrosis of the papular corium, and acanthosis of the epidermis with disappearance of the histiocytic infiltrate (low power). (*C*) Submiliary collections of the histiocytes were found infiltrating the corium and epidermis as shown in high power microphotograph of biopsy following roentgen therapy.

ent. The spleen and lymph nodes were enlarged, congested and massively infiltrated with mononuclear cells of the type observed in the lung. The lymph nodes contained multiple abscesses. The marrow cavities of the ribs and vertebrae and the interstices of the mastoid bone were infiltrated with the same type of large mononuclear cells. In addition, hemosiderosis and early focal abscesses were present. An early, specific mononuclear infiltration was present in the kidneys. The liver was enlarged and hemosiderotic and contained granulomatous lesions.

Comment. Case V demonstrates a particularly interesting pattern of the development of Letterer-Siwe's disease after the typical Hand-Schüller-Christian syndrome had been present at the onset of the child's illness. At the present time, in spite of voluminous literature on the interrelation between these several syndromes, further speculation is not helpful. The general impression seems to be that the Hand-Schüller-Christian syndrome is the more benign process, but in this last case the more malignant process developed rapidly.

DISCUSSION

Histopathology. The lesions in these cases were diffuse and nodular and were characterized by marked proliferation of histiocytes which showed a peculiar morphology. In general, the cells were moderately large, with light eosinophilic cytoplasm. The nuclei were moderately chromatinized and were round, oval, indented or folded. Occasionally, a few small vacuoles appeared in the cytoplasm. In the hemorrhagic lesions in Case I there was phagocytosis of erythrocytes by the histiocytes. Many of

the histiocytes were multinucleated. Slight or moderate lymphocytic infiltration and plasma cell reaction was present in the lesions. Eosinophils were not prominent except in lesions where necrosis had occurred.

The pulmonary findings differed somewhat in the first 3 cases. In Cases I and II there was diffuse involvement of the alveolar framework and peribronchial tissue with extension of the infiltrate into many of the alveoli. Fibrosis was not present nor was there evidence of significant inflammation due to pulmonary infection.

In Case III there was a somewhat different picture. Some areas of consolidation were composed chiefly of masses of histiocytes in the alveolar framework and alveolar spaces, with little fibrosis. The alveolar walls were markedly thickened by this process. The predominant process, however, was chronic bronchitis and pneumonitis. In these inflammatory lesions, proliferation was minimal and there was infiltration by large masses of reactive plasma cells. The chronic inflammatory process may be either the result of repeated episodes of infection or the result of the presence of the histiocytic infiltrate.

The cutaneous lesions were similar in all cases, being characterized by marked histiocytic infiltration (Fig. 7). In Case III a skin biopsy was made after 450 r had been given to an abdominal area in seven exposures over a period of six weeks. Clinically, the lesion had faded. On histopathological study, there was focal fibrosis of the papillary corium and acanthosis of the epidermis with disappearance of the histiocytic infiltrate in such area. Adjacent to these foci, however, numerous submiliary collections of histiocytes infiltrated the corium and the epidermis.

In Case III a slight variation in the histopathological picture of the spleen and lymph nodes was noted. Although many nodular proliferations of histiocytes similar to those of the other cases occurred, there was also fibrosis and marked hemosiderin deposits in these organs. Hemosiderosis was also present in the liver and bone marrow.

The lesions of the ribs in Case III showed evidence of chronicity. In addition to the massive histiocytic proliferation, there was fibrosis, hemosiderosis and phagocytosis of pigment and erythrocytes by the histiocytes. Phagocytosis of sudanophilic material, some of which was doubly refractile to polarized light, was present, but was not a prominent feature.

Roentgen Findings. Four of the 5 cases showed similar pulmonary lesions. Finely nodular densities, varying from 1 to 3 mm. were scattered diffusely throughout both lung fields. If the survival period was prolonged, pulmonary emphysema was associated. These changes were impressively similar to those associated with cystic fibrosis of the pancreas, acute histoplasmosis and disseminated tuberculosis. Only the association with skin lesions made them diagnostic.

In the acute process (Cases I and II) the pulmonary nodules were caused by the invasion of the interstitial substance by histiocytes. This infiltration involved bronchiolar walls, filled some alveoli and thickened the alveolar septa. In the more chronic stages, there was additional infiltration by inflammatory plasma cells which replaced histiocytes and a fine, diffuse interstitial fibrosis. One child showed extreme enlargement of the thymus gland.

The long bones showed progressive thinning of the cortex and widening of the medulla. Osteolytic lesions with sharply circumscribed borders as seen in the Hand-Schüller-Christian syndrome or eosinophilic granuloma were also present in 2 cases. The liver and spleen were enlarged in various stages of the disease.

The diagnosis of Letterer-Siwe's disease should certainly be considered in the differential diagnosis of finely nodular or miliary infiltrate in chest roentgenograms of infants and young children. The presence of a hemorrhagic skin rash, scaly dermatitis, especially over the scalp, enlargement of liver, spleen and lymph nodes

are important clinical findings. Biopsy of the skin lesions is diagnostic.

The treatment of the disease is unsatisfactory. The lesions are frequently extremely radiosensitive but recur. High voltage radiation therapy is helpful but not curative. As the patients become debilitated, secondary infections occur and the use of the newer wide range antibiotics will help in prolonging life.[1] The vigorous use of general supportive therapy is important. Specific therapeutic measures await the identification of an etiologic agent.

CONCLUSIONS

(1) Chest roentgenograms in Letterer-Siwe's disease show a striking, diffuse, irregularly nodular fibrosis of the lungs. When associated with the characteristic skin lesions, hepatomegaly, splenomegaly and lymphadenopathy, these chest findings can be highly diagnostic.

(2) There may be diffuse osteoporosis of bone with widening of the medullary cavity and narrowing of the cortex. There may also be areas of localized destruction similar to the characteristic lesions of the Hand-Schüller-Christian syndrome.

(3) The course of the disease is usually fatal. With increasing age, the course is somewhat prolonged, and therapy with antibiotics and radiation may prolong life.

(4) The clinically typical Hand-Schüller-Christian syndrome may suddenly develop into the fatal picture of Letterer-Siwe's disease.

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The authors wish to thank Dr. Ashley A. Weech, Professor of Pediatrics, University of Cincinnati, for his interest and encouragement in the preparation of this paper, and for supplying the data of Case v.

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DISCUSSION

DR. JOSEPH JAUDON, St. Louis, Missouri. I hope everyone here has availed himself of the opportunity to see Dr. Saenger's excellent exhibit of these 5 cases that formed the basis for this very fine clinical paper. I happen to be a pediatrician, and I am very happy to acquaint myself with a roentgenologist who is a good clinician, as exemplified by this splendid paper.

He has rightfully emphasized the diagnostic differentials in Letterer-Siwe's disease and other diseases of early infancy, particularly pancreatic fibrosis, miliary tuberculosis, histoplasmosis, and so on.

From a pediatric point of view, this disease is one that is spoken of as nonlipoid reticuloendotheliosis. The lipoid reticuloendotheliosis that we consider more benign is Hand-Schüller-Christian disease, and fortunately is more amenable to roentgen therapy than Letterer-Siwe's disease, which apparently involves more of the viscera and less of the bony structure.

However, as adequately pointed out by Dr. Saenger, the tubular bones are sometimes involved, but not specifically or diagnostically, in that they do show thinning of the cortex and a widening of the medulla.

In the past, we have had some difficulty in diagnosing a case of Hand-Schüller-Christian disease very similar to the one presented here by Dr. Saenger. The child had involvement of the mastoids, and was thought at first by the clinicians to be suffering from tuberculosis of the mastoid bone. He was operated on and the peculiar fatty deposits of foam cells so characteristic of Hand-Schüller-Christian disease were found.

The last case shown by the author demonstrates that these diseases are intimately related, that is the lipoid and the nonlipoid diseases. The fifth case showed typical Hand-Schüller-Christian involvement of the skull and diabetes insipidus, but later developed into a fulminating case of diffuse, nonlipoid reticuloendotheliosis. It is thought by some investigators to be the same disease; however, that has not been proved.

From a clinical point of view, it is important to realize that these children may look like cases of sepsis, and oftentimes have positive blood cultures of staphylococcus and pneumococcus, and it is not unusual for the terminal stage to show typical findings of sepsis.

I would also like to re-emphasize that a chest picture showing diffuse multiple miliary modulations of the lungs, if associated with a skin rash, and enlargement of the liver and spleen, should call for a diagnosis of Letterer-Siwe's disease until proved otherwise.

MILKMAN'S DISEASE (OSTEOMALACIA)

REPORT OF A CASE WHICH SHOWS THAT MILKMAN'S DISEASE MAY BE "SIMPLE" VITAMIN D DEFICIENCY IN ADULTS*

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MILKMAN'S disease or multiple spontaneous idiopathic symmetrical fractures was first described per se by Milkman[3,4] in 1930. Since that time many cases have been reported in both the American and foreign literature.

More recently, Albright *et al.*[1,2] have reviewed the entire subject of osteomalacia and have suggested four clinical classifications:

1. Chemical osteomalacia with normal phosphates.
2. Chemical osteomalacia with high phosphates.
3. Milkman's syndrome.
4. Advanced osteomalacia.

Milkman's disease seems to be, without question, an osteomalacia. It is felt, however, that it is merely one degree of osteomalacia, and that it is so designated because it is susceptible to a roentgen diagnosis.

The etiologies of osteomalacia given by Albright are as follows:

A. Vitamin D lack
   a. "Simple" vitamin D lack
   b. Resistance to vitamin D
   c. Steatorrhea
B. Renal acidosis
   a. Tubular insufficiency without glomerular insufficiency
   b. Fanconi syndrome
C. Idiopathic hypercalcuria
D. Hyperparathyroidism with osteitis fibrosa generalisata during transitional state following removal of parathyroid tumor.

Albright has recorded examples of Milkman's disease due to each of the foregoing causes, with the exception of that due to "simple" vitamin D lack, and states that, according to his knowledge, no case of this type has been recorded in the United States. The following case may fall into that category.

CASE REPORT

Mrs. R. R., aged thirty-six, of Italian extraction, well until 1939, when, aged twenty-four, she had a five months premature baby which died.

In 1930, she noted stabbing pain in her shoulders on motion, but they were not swollen, stiff, nor hot. Pain continued until 1933, when her shoulders became more painful and her gait assumed a "crab-like"character (waddling and widened). Her legs were stiff, but not painful. In 1935 the shoulder pain began to radiate down her back and was stabbing in character.

Each year from 1935 to 1940, the pain lessened in severity between September and February, and each March she would again have severe symptoms and the cycle would be resumed. In 1940 this remission was lacking for the first time, and she received 20 injections of lipo-iodine to the paraspinal muscles which made her feel worse. Following this, her condition progressed to the point where she was unable to walk and she was bedridden. This was in April, 1941, and she was admitted to the University Hospital for study, and the findings were as follows:

Systemic Review. She had a slight loss of appetite and some dysphagia associated with a distinct fear of choking, and because of this she took no pills and avoided most solid foods.

She disliked all dairy products. For the past fifteen years she had attempted to stay out of the sun. There was no steatorrhea nor evidence of liver disease.

Pertinent Physical Findings. A thin pale woman; prematurely gray hair; low grade bilateral corneal opacities; teeth in bad condition; pain and muscle splinting of the entire spine; local tenderness over thoracic 12, lumbar 1, lumbar 2, and lumbar 3, and pain on motion of

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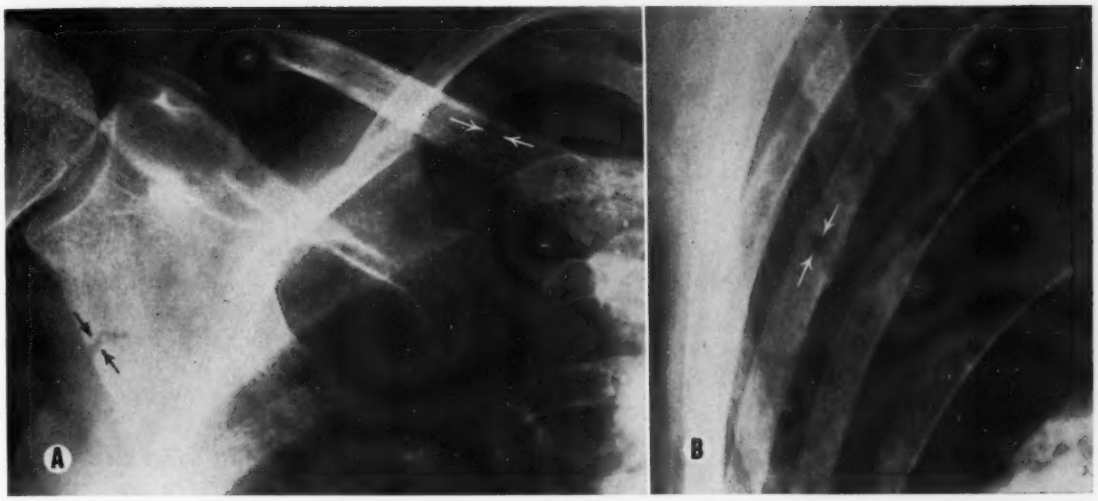

Fig. 1. (*A*) Pseudofractures of the inner third of the clavicle and the upper third of the lateral border of the scapula. The zone of rarefaction extends about ½ inch into the bone. (*B*) Pseudofracture through a rib. The zone of rarefaction extends entirely across the rib. These lesions were bilateral. This roentgen examination was made on April 14, 1941.

the shoulders, ribs, spine, and knees. The neurologic examination was entirely within normal limits.

Laboratory Findings. Red blood cells, 4.5 and 5.6 million per cu. mm.; hemoglobin, 83 and 81 per cent; reticulocyte count, 0.2 per cent; white blood cell count and differential, within normal limits; blood urea nitrogen, 7 mg. per 100 cc.; fasting blood sugar, 64 mg. per 100 cc.; serum chloride, 177 mEq. per liter; serum protein, 5.1 gm. per 100 cc.; serum calcium, 9.2 mg. per 100 cc.; serum phosphorus, 2.7 mg. per 100 cc.; serum alkaline phosphatase, 16.5 Bodansky units; urine, specific gravity ranging between 1.020 and 1.030; microscopic examination of four urine specimens, negative; Kolmer and Kahn serologic tests for syphilis, negative; sedimentation rate, normal on one occasion and subnormal on another.

Roentgen Examination. This revealed a generalized demineralization of all the bones of the body; a pseudofracture in the region of the right ischium and pubis; bilateral symmetrical pseudofractures in the region of the lesser trochanter of the femora; linear pseudofractures of the right scapula and clavicle; three early lesions in the right ulna; pseudofractures involving the ribs bilaterally; linear pseudofractures of the metatarsals; an isolated area of demineralization in the skull (Fig. 1, 2, 3 and 4).

The pseudofractures are isolated areas of decalcification without loss of bone continuity.[2]

Fig. 2. Two small defects in the cortex of the ulna (April 14, 1941).

FIG. 3. A defect on the medial margin of the second metatarsal (April 14, 1941)

Diagnosis. At this time, a diagnosis of Milkman's disease was made, although an exact etiology was not offered.

Treatment. She was treated with oral calcium and vitamin D in small doses with definite improvement of her symptoms in about ten days.

Recurrence of Symptoms. Six months later, in the fall of 1941, her symptoms recurred. She then had seasonal recurrences of symptoms every winter and spring until 1948, with complete remission in the summer and fall each year. In 1948 the symptoms became more severe and progressed in severity until May, 1950, at which time she was again a total bed patient. Her local physician treated her with vitamins in moderate doses and by the end of June, 1950, she was almost entirely without symptoms.

Re-admission to University Hospital in 1951 for additional study:

Systemic Review. At this time her symptoms were mainly those of a severe anemia. Except for some residual difficulty in walking, she had little in the way of bone difficulties. Her severe dysphagia and fear of choking persisted.

Physical Findings. These revealed a general shortening of stature with kyphosis; marked

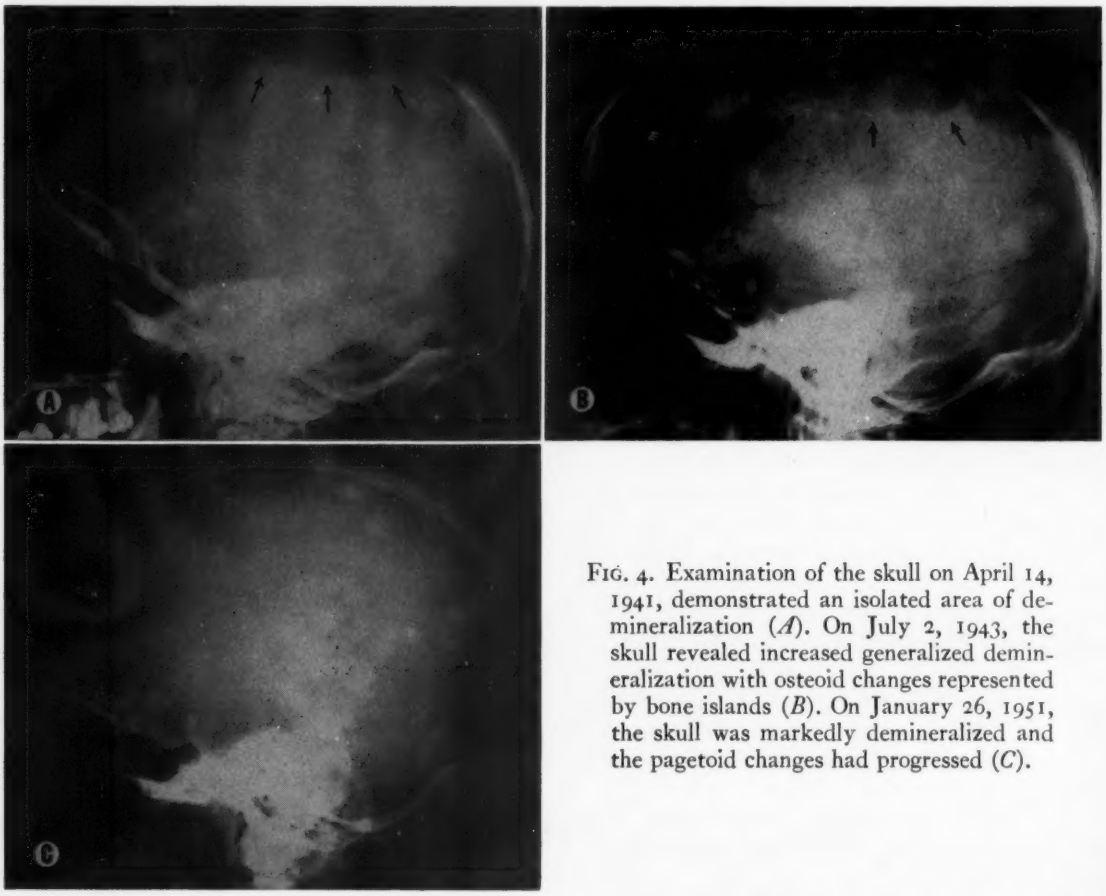

FIG. 4. Examination of the skull on April 14, 1941, demonstrated an isolated area of demineralization (*A*). On July 2, 1943, the skull revealed increased generalized demineralization with osteoid changes represented by bone islands (*B*). On January 26, 1951, the skull was markedly demineralized and the pagetoid changes had progressed (*C*).

pallor with a yellow bronzing of the skin; bilateral corneal opacities (slightly more severe than previously); soft, carious teeth with only seven lower and two upper ones remaining; bilateral annular cheilosis; pallor of the tongue and conjunctivas; slight tachycardia with a blowing systolic murmur; good peripheral pulses; no external evidence of bone tenderness; a negative neurologic examination.

Laboratory Findings. These studies showed: red blood cells, 3.5 and 2.6 million; hemoglobin, 34 and 35 per cent; reticulocyte count, 0.8 per cent; white blood cells, 7,000 per cu. mm., with a normal differential; blood urea nitrogen, 7 mg. per 100 cc.; fasting blood sugar, 90 mg. per 100 cc.; serum chloride, 104 mEq. per liter; serum protein, 6.8 gm. per 100 cc.; serum albumin, 3.9 and globulin, 2.9 gm. per 100 cc.; serum alkaline phosphatase, 62.5 Bodansky units (normal value is 3 to 4 units); carbon dioxide, 23.8 mM per liter; serum sodium, 129 and 137 mEq. per liter; serum potassium, 4.9 mEq. per liter; serum bilirubin, 1 minute of 0.02, total of 0.37 mg. per 100 cc.; prothrombin time, 66 plus or minus 20; serum cholesterol, 175 mg. per 100 cc.; with esters, 104 mg. per 100 cc.; thymol turbidity, 1.2 units; thymol flocculation, 0; cephalin cholesterol reaction, 0; gamma globulin, 2.8 K.U. (all within normal limits); normal sedimentation rate; repeated examinations of urine, negative; urinary calcium, 0.0184 gram per twenty-four hours after thirteen days on a Reifenstein diet,[2] which is a normal value for urinary calcium excretion; vitamin A serum level, 29 mg. per 100 cc. (normal); examination of the stools grossly revealed no evidence of a floating, fatty, or foul smelling stool, and microscopically there was no evidence of neutral fats.

Roentgen Examination. As on the former examination, there was a generalized demineralization throughout the entire skeletal system. There was evidence of an old pseudofracture in the right scapula; an increase in the size of the vertebral bodies with a marked coarsening in their trabeculation; pagetoid changes in the skull (Fig. 4, 5 and 6). All other pseudofractures had healed.

Final Diagnosis. Osteomalacia or Milkman's disease secondary to "simple" vitamin D lack.

DISCUSSION

This patient illustrates a twenty-one year history of osteomalacia in different stages with at least one period in which a classical Milkman's type syndrome was present.

FIG. 5. The vertebrae are wider than normal. They are increased in density and show prominent trabeculation. This has been described as pagetoid changes due to the laying down of excess osteoid tissue in times of negative calcium balance, and its failure to reabsorb in times of positive calcium balance (January 26, 1951).

All tests of renal and hepatic function were negative. Urinary calcium excretion was within normal limits. With the absence of a history suggesting steatorrhea over a long period of time and the finding of normal stools, normal prothrombin time, and normal vitamin A and carotene serum levels, faulty gastrointestinal absorption would appear to be unlikely. Thus, the Albright categories, A.b., A.c., B, C, or D, regarding osteomalacia are unlikely etiologies for this patient's symptom-complex.

The patient demonstrates a long series of relapses and remissions, the latter being brought about by administering small doses of vitamin D and calcium (alkali was never given). She had a history of avoiding sun-

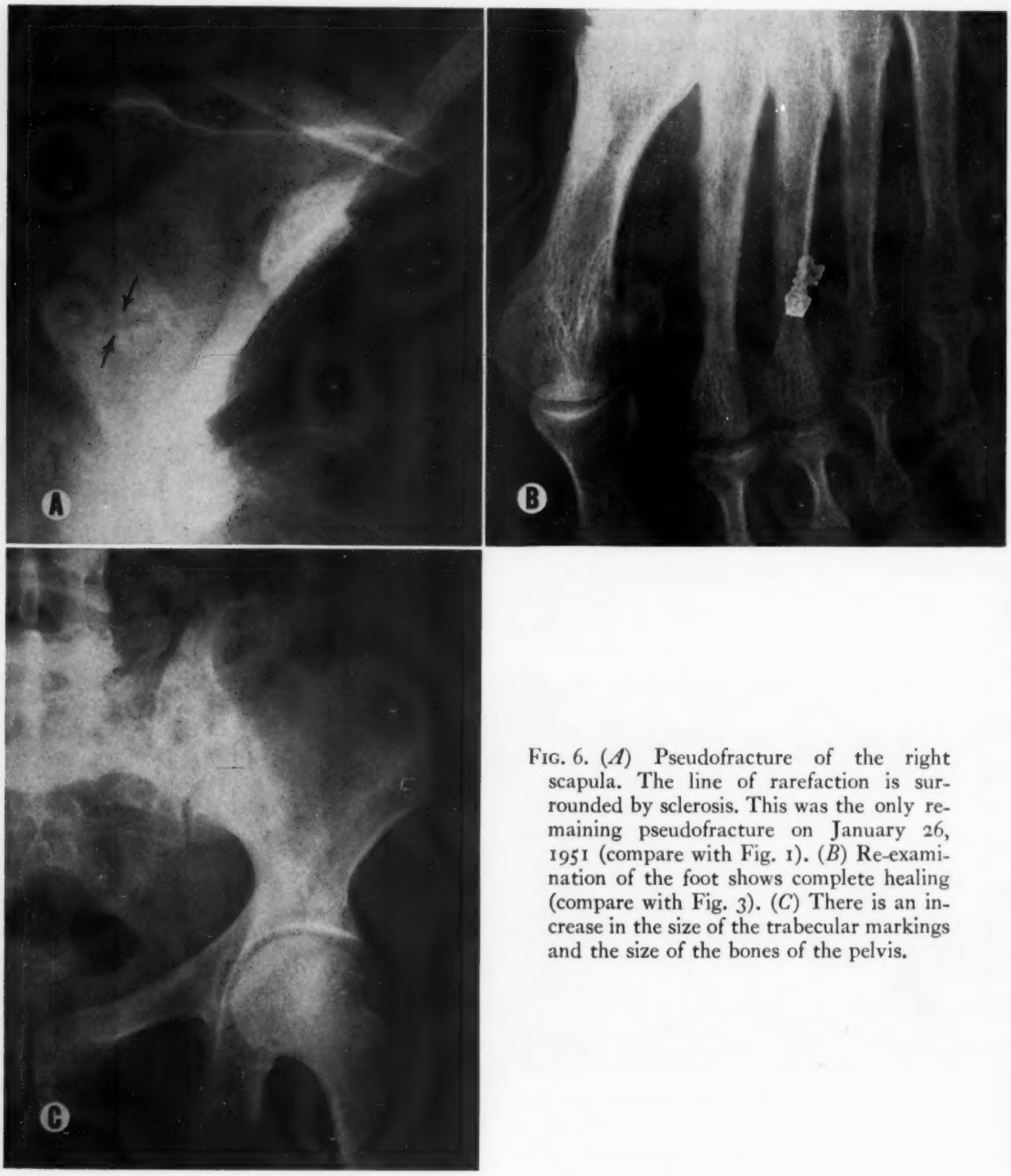

Fig. 6. (*A*) Pseudofracture of the right scapula. The line of rarefaction is surrounded by sclerosis. This was the only remaining pseudofracture on January 26, 1951 (compare with Fig. 1). (*B*) Re-examination of the foot shows complete healing (compare with Fig. 3). (*C*) There is an increase in the size of the trabecular markings and the size of the bones of the pelvis.

light and dairy foods, and a physical examination consistent with vitamin deficiency (annular cheilosis). In view of the foregoing, A.a., or "simple" vitamin D lack appears to be the best explanation for the osteomalacia exhibited in this case.

It is interesting to note that she was controlled easily at all times with small amounts of medication. This suggests the possibility of a good therapeutic result in some cases of Milkman's disease, which is contrary to the original reports.[3]

This patient has demonstrated at least two stages of osteomalacia: Albright's group 3—Milkman's syndrome and his group 4—advanced osteomalacia. The orig-

inal roentgen examination revealed the multiple symmetrical pseudofractures similar to those described by Milkman. These lines of decalcification rapidly disappeared under therapy never to appear again. Following this there was a gradual increase in the generalized osteomalacia through the years (Fig. 4).

In addition to this generalized osteomalacia, we observed another finding which has been described as pagetoid changes in the bones.[5] It is felt that during the period when calcium is not being laid down in the bone the osteoid tissue is even more active than normal. This results in an increase in the osteoid tissue which is not easily reabsorbed in times of positive calcium balance. Thus, after therapy, when calcium is once again laid down in the bones, they assume a much thicker appearance than normal and the trabeculae are markedly coarsened. This is very well demonstrated in the lumbar spine (Fig. 5).

SUMMARY

1. A case of Milkman's disease observed for ten years showing a distinct relationship between symptoms and therapy is described.

2. An unusual etiology, "simple" vitamin D lack, is proposed.

3. The case demonstrates a transition from a Milkman's type osteomalacia to a generalized osteomalacia, as well as pagetoid changes in the spine, probably the result of the long-standing osteomalacia which had healed.

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A METHOD OF ROENTGENOGRAPHY OF THE MALE GENITAL TRACT*

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INJECTIONS of the vas deferens were first made in 1905 by Belfield, who used antiseptic solutions as a method of therapy. The use of this method for diagnostic studies of the male genital tract also is to be credited to this pioneer, who in 1913 published three articles on the roentgen visualization of the seminal vesicles.[1,2,3] Since then, reports based on the method have been made by Belfield and Rolnick,[4] Wilhelm,[17] Bertelsen and Wandall,[5] Heller,[7] Staehler,[13,14,15] and Pohjola and Tuovinen.[11]

A further contribution to our knowledge of the seminal vesicles and ejaculatory ducts, and frequently the vasa deferentia as well, was made with the introduction in 1920 by Young and Waters[19] of a technique for the *retrograde* catheterization of the male genital tract. Seminal vesiculograms made in this manner have since then been reported by Peterson,[10] Herbst and Merricks,[8] Martins Costa and Negrini,[9] Tavolaro,[16] Gonzales-Iman,[6] and Puigvert.[12]

In spite of the appearance in the literature of vesiculograms made by these authors over a period of thirty-eight years, the methods remain essentially unknown. The anatomical relationships of the normal male genital tract, let alone the abnormal, are known to but a minority of physicians. In the words of Belfield and Rolnick, "For many surgeons and physicians, the seminal vesicles do not exist."

Studies of the male genital tract were initiated by one of us (H. Y.) in the Dairen General Hospital in Manchuria, and a report on the first 59 cases made in 1935.[18] Since that time the examinations have been continued, and roentgenograms have been obtained on a total of more than 400 patients following injection of opaque media. The work has in recent years been done in the urologic clinic of the Hiroshima Medical College in Kure, Japan. Here the facilities of the Atomic Bomb Casualty Commission were utilized to obtain roentgenograms of 18 patients following the injection of the vasa deferentia. This report summarizes the findings on these 18 men.

ANATOMY

The accompanying diagram (Fig. 1) illustrates the structures in the male genital tract and the approach to them used by us in this study. Apparently there are wide variations in the size and contours of the seminal vesicles among normal individuals, as will be seen in our illustrative roentgenograms. The vasa deferentia are smooth-walled tubes of rather uniform caliber through most of their length, but the ampullas have serrated margins which sometimes cause a shaggy appearance or may closely resemble multiple small diverticula.

METHOD

The spermatic cords are carefully palpated, and each vas deferens securely fixed by application of a special clamp (Fig. 2). After infiltration with local anesthetic, an incision less than 1 centimeter long is made in the skin made tense by the clamp. Following freeing of the vas deferens, it is a simple matter to insert in it a 25 gauge needle and inject slowly the solution used as contrast medium. Usually 1.5 cc. injected upward (distally) on each side is

* This work was partially sponsored by the Atomic Bomb Casualty Commission, National Research Council, with funds supplied by the United States Atomic Energy Commission.

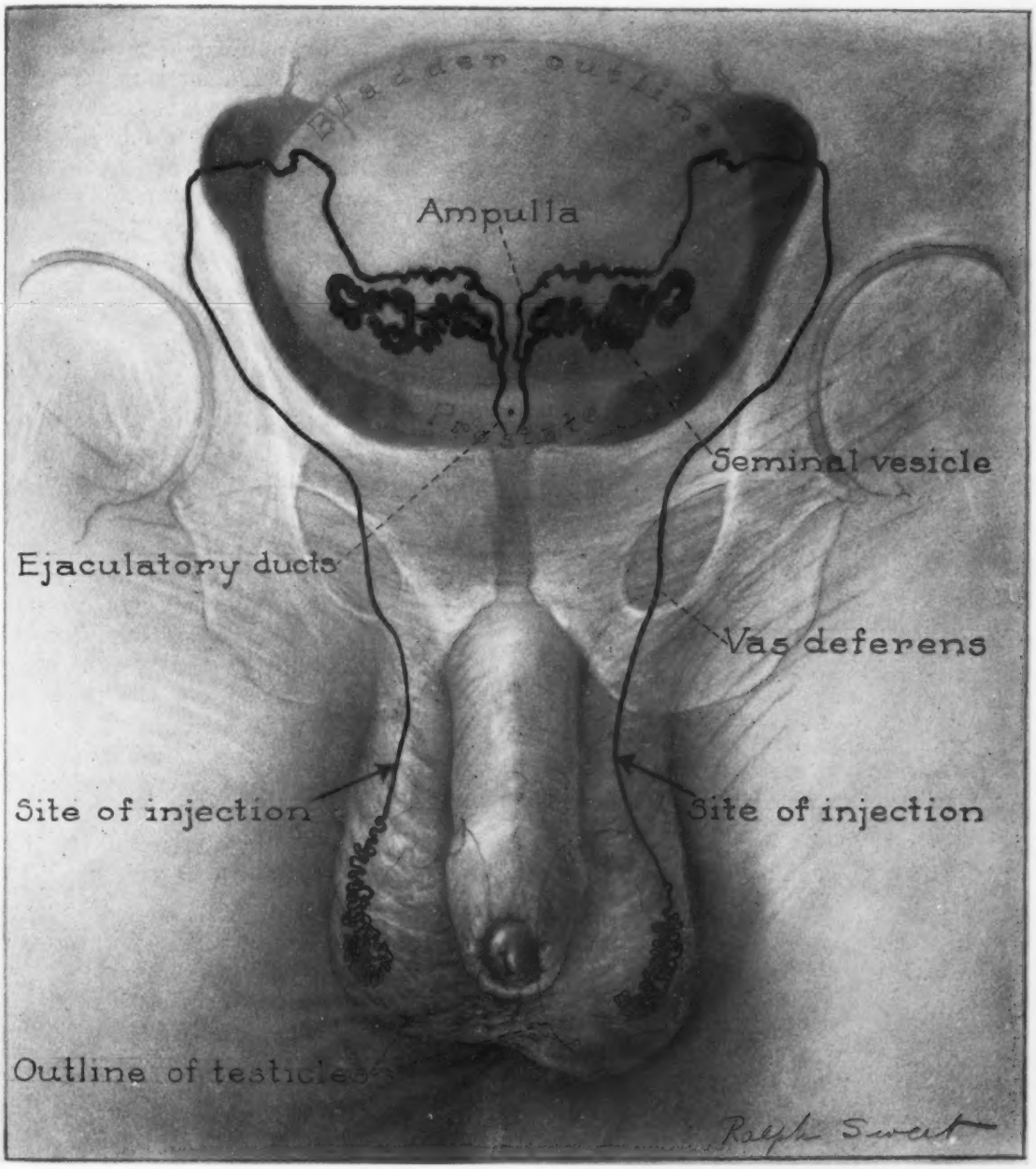

Fig. 1. The male genital tract. The sites of exposure of the vasa deferentia are indicated, into which injections of the contrast medium are made upward, and frequently downward.

sufficient to fill the duct and the seminal vesicle, but in some instances 2 cc. is used. Any excess of medium over the capacity of the system is discharged into the prostatic urethra, where it may go either up into the bladder or down into the distal parts of the urethra.

In order to avoid confusing shadows on the roentgenograms from the presence of this overflow, the patient is asked to void before the films are made. In any event, a lapse of several hours is usually permitted between the injection and the roentgenography, so as to allow time for the medium to mix with the secretions already present in the acini of the seminal vesicles. In fact,

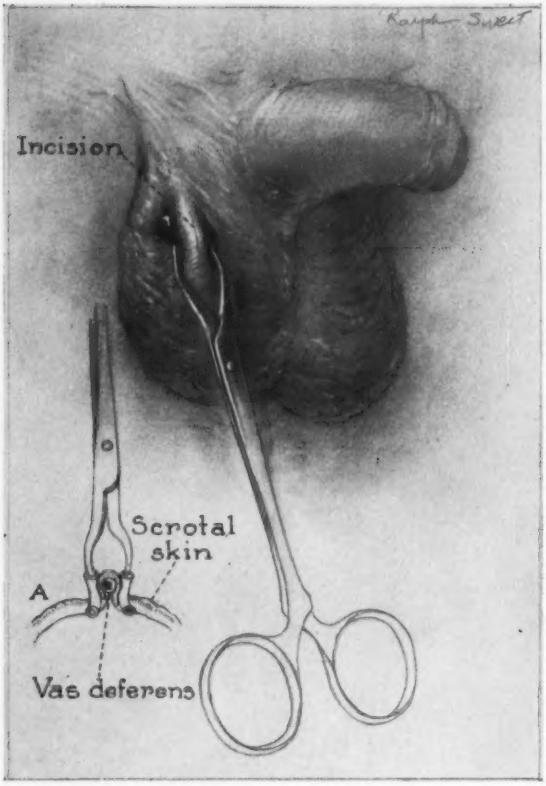

FIG. 2. Special clamp, applied to the scrotum to fix the spermatic cord. Inset (*A*) shows the fixation of the vas deferens in cross section.

the filming may frequently be delayed several days without great effect on the resulting roentgenogram. The rate of emptying of the genital tracts varies tremendously, depending upon the occurrence of intercourse or other means of discharge of the spermatic fluid.

Where visualization of the proximal portions of the vasa deferentia is desired, the needle is turned about and an injection made in each vas deferens downward. Three-tenths to 0.5 cc. is usually the amount that can be contained in the proximal vas deferens and cauda epididymis, which is as far as the caliber of the lumen will allow penetration of the media which we have used.

In this study the time of roentgenography has ranged, for the 18 cases, from two to seventy-two hours following injection of the contrast medium (see Table 1). In those cases filmed as early as two to four hours after injection, filling appeared to be satisfactory on our roentgenograms. In one case roentgenographed as late as fifty-four hours there likewise was good filling, but 2 cases filmed after seventy-two hours did not give complete pictures of the tracts. One case (Case 1) had a re-examination one week after his initial successful film, which showed somewhat less umbrathor in the vasa deferentia after that interval, but essentially the same distribution of the medium in the vesicles as originally.

CONTRAST MEDIA

The metal found by one of us (H.Y.) to make the most satisfactory contrast medium is *thorium*. Thorium is obtainable in forms that are nonirritating to the tracts, and casts shadows opaque enough for clear visualization. The radiopacity of an element being proportional to the fourth power of its atomic number, thorium, with an atomic number of 90, clearly casts denser shadows than barium (56) or bismuth (83). This agent is available as colloidal preparations of thorium dioxide, of which two are on the market, umbrathor and thorotrast. Both sols contain 25 per cent thorium dioxide, which corresponds to 22 per cent metallic thorium.

The usefulness of *umbrathor* depends largely upon its acidity (pH 3.0) and its property of flocculating and becoming a surface coating. Its flocculation on making contact with normal mucosa is well known and is the feature rendering the medium valuable in roentgen studies of the stomach and intestine. Less well appreciated is its property of flocculating when in contact with body fluids—which is what makes it of value in a study of the contents of the vasa deferentia and the seminal vesicles. This tendency produces a precipitate on the mucosal surfaces of these organs which is dense enough to allow their contours to stand out clearly. Unfortunately, as this precipitate forms it tends to coalesce, with the result that there is an uneven distribution of the metal which appears on roent-

TABLE I

CASES STUDIED BY SEMINAL VESICULOGRAPHY

Medium: U = Umbrathor, T = Thorotrast
Time = Hours between injection and roentgenography

Case No.	Age	Medium	Time	Clinical Diagnosis
		Normal Male Genital Tracts		
1	20	U	L. 24, R. 4½	Syphilis, secondary
2	26	U	72	Hypoplastic kidney
3	58	U	5	Bladder and prostate calculi
4	23	U	5	Ureteral calculi
5	32	U	4½	Impotence
6	31	U	3½	Urethral stricture
7	43	T	4½	Chronic eczema
8	42	T	4½	Impotence
9	25	U	2	Gonorrhea
10	69	T	54	Vesical calculus; prostatic hypertrophy
11	44	T	3½	Prostatic hypertrophy
12	31	T	23	Tuberculosis, bladder and prostate
13	49	T	23	Carcinoma of bladder
14	42	T	4½	Chancroid
		Abnormal Male Genital Tracts		
15	36	U	72	Tuberculosis, left epididymis
16	53	U	5	Carcinoma of bladder
17	19	L.T, R.U	4½	Tuberculosis, right kidney and bladder
18	71	T (R. only)	23	Calculi in seminal vesicles

genograms as a sort of dot-and-dash system.

The acidity and flocculation property of umbrathor are what preclude its use, of course, in roentgenography of veins and arteries. Thrombosis may be expected should any of this substance inadvertently be introduced into a vessel.

Thorotrast is also a thorium dioxide sol, but there its similarity to umbrathor ends. This colloid is a highly dispersed suspension of fine particles, ranging from 3 to 10 millimicra in diameter. Its stability and neutral reaction render it safe for intravascular injection without danger of local irritation. Unfortunately, however, once it enters the blood stream it is picked up and retained by the cells of the reticuloendothelial system, where its half-life of 1.39×10^{10} years provides prolonged exposure to the alpha particles it emits, and other rays from its decomposition products.

These considerations do not weigh heavily in the use of thorotrast in the genital tract. The material is not introduced into any vascular structure, and even if the total dose should by error be injected into a blood vessel, the amount used is but one-twentieth of that given in the usual intravenous dose for visualization of the liver.

Since thorotrast does not flocculate in the manner of umbrathor, the concentration of thorium within the lumens of the male genital organs is less than in the case of umbrathor, and the resulting shadows on the roentgenograms are less dense. What the roentgenograms with thorotrast lack in contrast, however, they make up in providing more continuous outlines of the systems, because the dispersal of thorotrast is uniform whereas that of umbrathor is discontinuous. The relative features of the two thorium media may be seen in the accompanying reproductions of roentgenograms.

The thorium dioxide introduced into the

genital tract of the male is, as far as we have been able to observe, eventually excreted in its entirety from the body—whether it is umbrathor or thorotrast that is used. A very small amount of radiation is absorbed from the presence of a few cubic centimeters of the medium within the body for a period of days (usually) before it is discharged via the urethra. A greater exposure is obtained in the event of an extraluminal injection of the medium, as then the material remains in the patient indefinitely. The tendency for thorotrast to induce marked fibrosis in the tissues into which it is infiltrated must give us pause, also, because a greater or lesser amount of extravasal injection of the medium is a frequent concomitant of the method. Examples in this series are Cases 1, 8, 11 and 12 (most of whose injections were made by assistants whose experience was limited). We have not yet had late follow-up studies of these patients to see whether they may have developed fibrosis which might lead to complete occlusion of their vasa deferentia.

Of the 35 vasa deferentia injected in our 18 cases, umbrathor was used in 19 and thorotrast in 16 (Table 1). The only reaction noted in this series was one instance (Case 11) of chills and fever, which subsided within five hours. No infection was discovered in the patient to account for the symptoms, and it is possible that the reaction may have been caused by insertion of the medium into the sheath of one of the vasa deferentia instead of into its lumen when proximal injection was attempted. Such reactions have been rare among the hundreds of cases injected with thorium compounds in Dairen and in Kure. No serious complication has been seen in any case.

MATERIAL

Eighteen men from the Urology Clinic of the Hiroshima Medical College Hospital were subjected to the procedure during a year between June, 1949, and May, 1950. Each gave his permission to receive the injection. All but one had complaints referable to the genitourinary system, that exception being a patient with chronic eczema. Of the 17 with genitourinary symptoms, 15 were found to have organic disease, and 2 had the complaint of impotence which was not explained. The pathological findings frequently had no bearing on the genital portion of the genitourinary system, with which we are concerned in this report. A list of the cases is given in Table 1. The ages of the patients ranged from nineteen to seventy-one years.

Bacteriological and pathological studies being expensive luxuries in Japanese medicine, the clinical diagnoses are for the most part without laboratory confirmation. As far as could be ascertained clinically, no harmful residua resulted locally from the introduction of the thorium compounds. There have been no surgical or postmortem specimens in this series for study of reaction in the tissues.

RESULTS

Films made after injection of 35 vasa deferentia in 18 men showed good visualization of the vasal ampullae and the seminal vesicles in 33 instances. Of the remaining 2, in one (Case 8) there was clearly a failure to inject the vas, and in the other (Case 18) the films made twenty-three hours later showed no trace of the contrast medium—whether because it never entered the system, or had meanwhile passed out, is not known.

In the accompanying summaries, this latter case is listed among the 4 which are called abnormal. The other 14 exhibited no intrinsically pathological process within the vasa deferentia or seminal vesicles and are therefore called normal, although, as may be seen from perusing the summaries, frequently abnormalities have been encountered elsewhere in the genitourinary tracts, such as calculi, tuberculosis, prostatism, malignancy, or venereal disease.

A considerable variation in the morphology of the vasa deferentia and seminal vesicles has been encountered, and is apparently without pathological significance. Representative examples of the normal and

abnormal configurations are shown in the accompanying illustrations.

In some cases injections of the opaque medium were made proximally in the vasa deferentia as well as distally, without quite so great a degree of success in filling. No abnormalities were recognized in the proximal parts of the vasa deferentia or the caudata epididymides which were filled in this series. A few reproductions are given of the films obtained by this process.

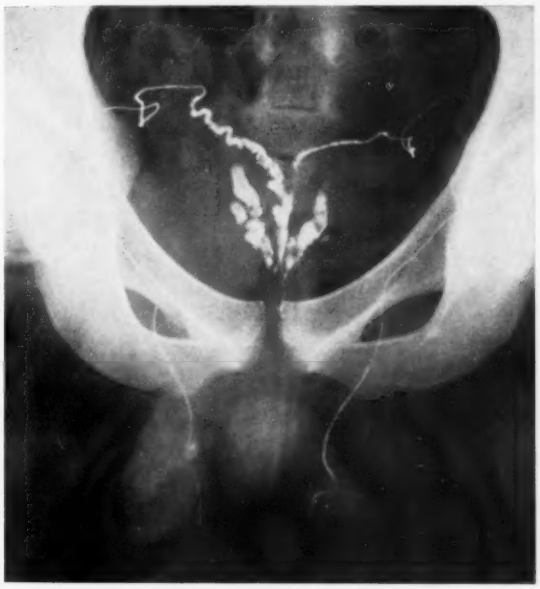

FIG. 3. Case 1. Umbrathor. Normal seminal vesiculogram. The distal segment of the right vas deferens is larger than that of the left. The right seminal vesicle is slightly better filled than the left. Perivasal injection of some of the umbrathor is to be seen at the injection site on the right. The injection of the left vas was made twenty-four hours before this film, that of the right four and a half hours.

REPORT OF CASES

Normal Male Genital Tracts

CASE 1. (Fig. 3, 4 and 5) Three week history of a skin eruption considered clinically to be secondary syphilis and syphilid. Wassermann reaction 3 plus. Injection of the left vas was made the day before the roentgen examination, that of the right only four and a half hours before, but the film shows good filling of vasa and seminal vesicles on both sides. One week later the amount of medium is less, but the distribution in the distal parts of the vasa and the seminal vesicles is essentially the same.

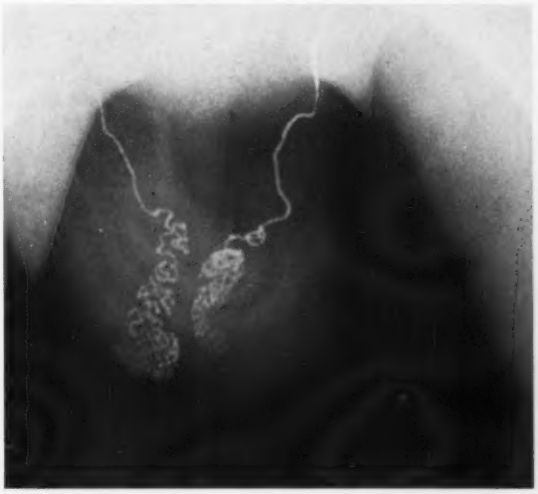

FIG. 4. Case 1. Filling of the distal portions of the epididymides achieved at the same time as Figure 3. Greater filling has been obtained on the right than on the left.

CASE 2. An excretory urogram showed such poor excretion on the right that a diagnosis of renal tuberculosis was made. The injection of umbrathor into the deferential system shows no evidence of tuberculous involvement of the vasa or seminal vesicles, but is not conclusive because of incomplete filling, perhaps as a result of a delay of three days between the injection and the roentgenography. Operation

FIG. 5. Case 1. Umbrathor. One week after Figure 3. The umbrathor has flocculated to a considerable degree on the mucosa of the vasa and the seminal vesicles. The right seminal vesicle still appears better filled than the left.

Fig. 6. Case 3. Umbrathor. Probably normal vasa deferentia and seminal vesicles. The large calculus in the bladder is most conspicuous. Huge ampullas in the ducts behind the symphysis pubis are filled with opaque medium which, from its diminished density, must be diluted with secretions. The acini of the seminal vesicles are irregularly filled by the umbrathor, probably as the result of containing other matter.

was subsequently performed, which revealed no evidence of infection, but a markedly hypoplastic right kidney.

Case 3. (Fig. 6) Complaint of hematuria. Films show a large bladder calculus, and dense shadows in both lobes of the prostate. Three days after seminal vesiculography a suprapubic cystotomy was performed, with delivery of two vesical calculi, a large one weighing 11 gm. and a small one of 0.5 gm.

Fig. 7. Case 5. Umbrathor. Normal vasa deferentia and seminal vesicles.

Case 4. Hematuria and attacks of abdominal colic. Seminal vesiculography is negative. Three calculi found in left ureter.

Case 5. (Fig. 7) Complaint of impotence for six years. Roentgenograms following injection of umbrathor are entirely normal.

Case 6. (Fig. 8) Urethritis for many years, probably on the basis of an original gonococcal infection. A stricture had been dilated numerous times, but recently a urethral fistula had developed, with extravasation of urine. Roentgen examination made following the injection of umbrathor into each vas shows normal vasa and seminal vesicles, but there are numerous collections of the diluted medium along the course of the urethra, apparently within sinuses and diverticula.

Fig. 8. Case 6. Umbrathor. Chronic urethritis, with stricture, sinuses and fistula. The umbrathor, considerably diluted, may be seen in outpouchings along the course of the urethra behind the symphysis pubis. The vasa deferentia and seminal vesicles are probably entirely normal, although the distal segments of the vasa have a ragged appearance which suggests diverticulosis. The left ejaculatory duct is well filled with umbrathor, up to its orifice in the prostatic urethra.

Case 7. (Fig. 9) Complaint of generalized pruritus, but only mild eczema was found on examination. Because the dermatology and urology patients are seen in the same clinic in Japan, it was not difficult to persuade the

man to submit to injection of his vasa with thorotrast. The resulting films show the distal ends of the vasa and the seminal vesicles to be unusually large but probably quite normal.

Case 8. Impotence. Seminal vesiculography had been performed four months previously, but with Japanese roentgenographic equipment the results were inconclusive. On our examination good delineation of a normal epididymis, vas and seminal vesicle had been obtained on the right, but injection of the left was not achieved.

Case 9. (Fig. 10) Patient had had an acute

Fig. 9. Case 7. Thorotrast. Normal seminal vesiculogram.

gonorrhea, treated with "sulfa" and penicillin. He was given intravasal injections of umbrathor experimentally, and the films made two hours later are normal.

Case 10. (Fig. 11) An elderly patient with hesitancy and dysuria. Rectal examination showed an enlarged prostate. Cystoscopy had revealed a vesical calculus, which had been crushed. Films made after injection of thorotrast show no intrinsic irregularity of vasa or seminal vesicles, but the right vas is seen to deviate rather sharply in the lateral part of the pelvis around an object of laminated structure, probably a calculus. The calculus apparently is not in the vas, and may lie within a diverticulum of the bladder.

Case 11. (Fig. 12 and 13) Prostatism with possibility of carcinoma. At the time of roentgenography, three and a half hours after injection of thorotrast, the man was having a reaction consisting of chills and fever. The films show normal vasa and seminal vesicles. In an

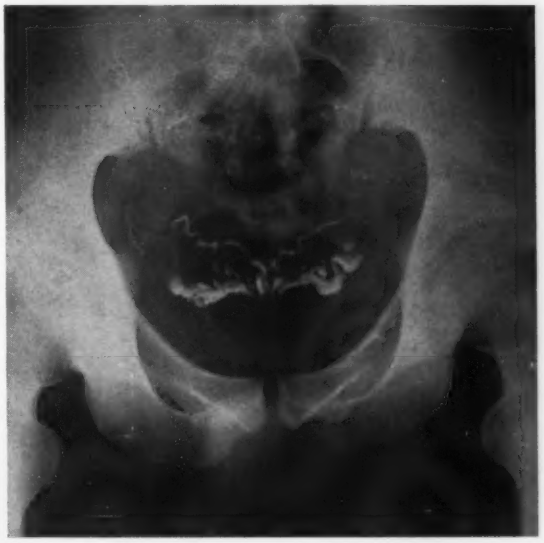

Fig. 10. Case 9. Umbrathor. Normal. The ejaculatory ducts are filled, and locate the verumontanum between them.

attempt to inject the medium proximally in the vasa, a normal picture has been obtained of the right epididymis, but on the left only a faint circular shadow is seen, probably from thorotrast in the tunica vaginalis.

Case 12. Large prostate. Cystoscopy showed an inflammatory condition in the bladder thought to be tuberculosis. Films made after

Fig. 11. Case 10. Thorotrast. Normal seminal vesicles in an elderly man known to have vesical calculi. A laminated calculus is present in the right lateral portion of the pelvis, around which the vas deferens may be seen in stereoscopic films to deviate rather sharply. The films also show a bilateral malum coxae senilis, with fusion of the left hip.

FIG. 12. Case 11. Thorotrast. Normal vasa deferentia and seminal vesicles. Irregular dense streaks over the left side of the scrotum represent leakage of the opaque medium into the dressings.

injection of thorotrast show normal seminal vesicles and left epididymis. The attempt at injection of the right epididymis has resulted only in extravasal infiltration.

CASE 13. Hematuria for one month. Cystoscopy revealed a large carcinoma occupying the right half of the bladder. Films made after the injection of thorotrast nevertheless show no irregularity of vasa or seminal vesicles.

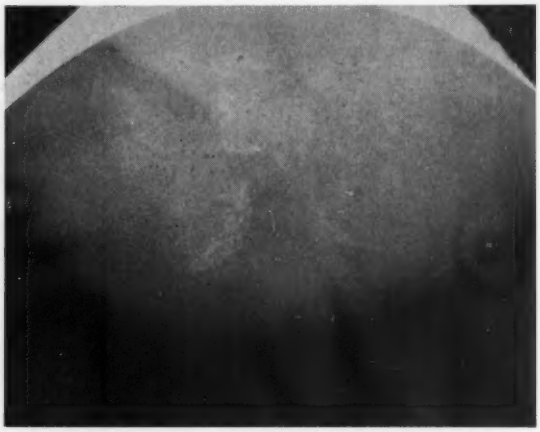

FIG. 13. Case 11. Thorotrast. Considerable difficulty was experienced in taking a soft tissue film, as the chills which the patient was having at the time, apparently as a result of the injection, caused marked shortening of his spermatic cords. This made it hard to project the scrotum onto a film away from the thighs. The contrast medium on the right has the pattern of a normal epididymis, but that on the left conforms to the configuration of the tunica vaginalis.

CASE 14. History of perineal pains in this forty-two year old man for thirty years, worse in the past three. On examination he was found to have chancroid, and an inflammation of the bulbo-urethral glands. Films made after the injection of thorotrast show normal seminal vesicles and left vas deferens, but there is an unexplained aberrant course of the right vas, whose distal part crosses the midline and terminates almost parallel with the left vas.

Abnormal Male Genital Tracts

CASE 15. Enlargement of epididymides, particularly the left, considered to be tuberculous.

FIG. 14. Case 16. Umbrathor. Carcinoma of the bladder with probable involvement of the left seminal vesicle which has dilated and frayed acini. The irregular appearance of the right seminal vesicle is not necessarily due to malignancy, but may be entirely accounted for by the retention of secretions and spermatozoa. The ragged appearance of the distal segments of the vasa deferentia, as if multiple small diverticula were present, is probably entirely normal.

Films made three days after the instillation of umbrathor into the vasa deferentia show rather poor filling of the vasa and seminal vesicles, but large irregular collection of the medium in the vicinity of the right seminal vesicle indicates a destructive process in this organ, presumed to be on a tuberculous basis.

CASE 16. (Fig. 14) Complaint of hematuria. Cystoscopy showed a large fungating carcinoma on the right wall of the bladder. Films made five hours following the injection of

umbrathor into the vasa show a normal right seminal vesicle, but dilatation and fraying of the left, likely from carcinomatous involvement.

Case 17. (Fig. 15 and 16) The youngest patient in our series was nineteen years old. Complaints of frequency of urination and burning. Urine loaded with red and white blood cells. A diagnosis of renal tuberculosis was made, and right nephrectomy performed sixty-eight days prior to our seminal vesiculography. The bladder had also been found to be involved by the infection. Our films show a normal right vas and seminal vesicle, but on the left there is dilatation and pooling of the medium, indicating a destructive process in the seminal vesicle which is probably tuberculous.

Fig. 15. Case 17. Umbrathor in right, thorotrast in left. Tuberculosis, left seminal vesicle. Marked dilatation and loss of integrity of the acini. The distal portion of the left vas is somewhat dilated. The right vas and seminal vesicle do not appear to be involved.

Case 18. (Fig. 17) This seventy-one year old man, the oldest in our series, gave a history of left orchidectomy thirty-seven years previously, but the reason therefor was not clear. Lately he had been having hematuria and pain, and had passed small bits of gravel. Films made prior to seminal vesiculography showed dense shadows in a retropubic distribution.

Injection of the right vas deferens only was done, because of the difficulty of identification of the atrophied left. Films made a day after the injection of thorotrast fail to show any evi-

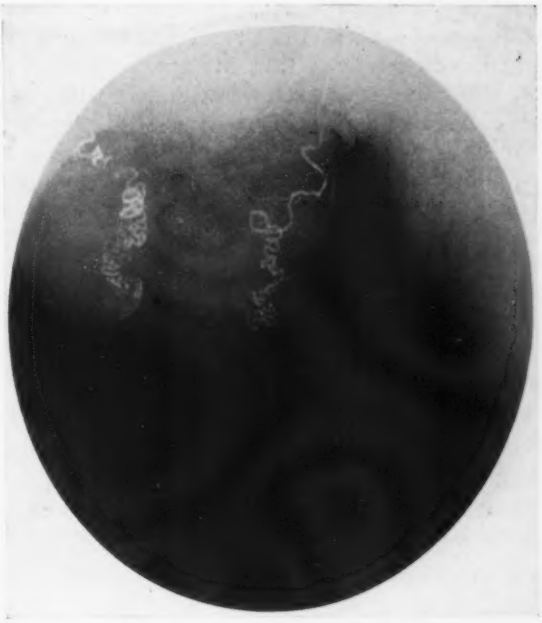

Fig. 16. Case 17. Umbrathor in right, thorotrast in left. Normal epididymides in the same patient as Figure 15. The slightly greater degree of filling of the right then the left is not necessarily a function of the media used.

dence of the medium in the genital tract, and the appearance of the retropubic opacities is the same as it was before the injection. Five days later a prostatic exploration was per-

Fig. 17. Case 18. Thorotrast injected twenty-three hours previously into the right vas deferens, but none is visible at this time. The grape-cluster densities overlying the symphysis pubis apparently represent calculi in the seminal vesicles.

formed through a perineal incision, but no calculi were found in the prostate. The surgeon therefore considered that the opaque shadows in the roentgenograms were an indication of calculi in the seminal vesicles.

SUMMARY

Roentgenograms made following the injection of colloidal thorium dioxide into the vasa deferentia of 18 Japanese men have been included in a diagnostic study of these patients. A wide variation in the form of the male genital tract has been encountered. An experience with more than four hundred such vasoseminal vesiculograms has been used as a basis for evaluation of these films, of which a select number are here reproduced to illustrate normal and abnormal patterns.

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Vol. 71, No. 3

THE TREATMENT OF CANCER OF THE CERVIX UTERI

A COMPARISON OF RADIATION THERAPY AND RADICAL SURGERY*†

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STATISTICS showing cure rates in cancer of the cervix uteri as reported from various clinics have not led to any final conclusion as to the effectiveness of different methods of treatment. The reason for the failure of such statistics to provide a decision between even such dissimilar methods as radical surgery, on the one hand, and irradiation, on the other, is to be found particularly in the wide variations in the original extent of the disease of the patients upon which the reports are based.

The importance of this original difference in the character of the clinical material is evident from five year survival rates which, in spite of apparently negligible dissimilarities in techniques of therapy, have sometimes shown a range of from 19 per cent[11] to 53 per cent.[10] Such differences in the basic material may result from factors operating selectively both inside and outside of the institution. The location or reputation of a hospital may be such that only advanced cases apply to it or, on the other hand, it may be known that the bed space is limited and only favorable cases will be received with enthusiasm. When surgery is employed the factor of selectivity is even more important, since the operability rates have varied from low figures of 10 per cent to 15 per cent (Read, 14 per cent;[20] Meigs, 7.5–10 per cent;[16] Morton, 10 per cent[19]) to figures of over 50 per cent (Bonney,[2] Stoeckel,[22] Brunschwig[5]). Finally, the apparent tendency for women with cancer to present themselves somewhat earlier, as the result of continuing lay education, introduces a factor of error whenever even within a single institution, the results of treatment during one decade are compared with those of a preceding one.

To solve this problem, it appears essential to set up a contrasted series which eliminate, so far as possible, errors arising from differences in the original case material due either to institutional selection or to the year in which they are treated. A theoretically perfect plan would be to classify all cases applying to a given clinic by stages according to the International Classification, and then to assign cases within each stage in strict alternation to one or the other systems of therapy to be contrasted.

During 1945 and 1946 such a plan was put into practice at the Memorial Hospital where the authors were at that time members of the gynecological service. During these years 87 patients with Stage I or II cancer of the cervix were assigned, according to such a plan, either to a group to be treated by radical surgery or to one to be managed entirely by radiation methods. More than five years have elapsed since the last of this series of cases were treated, so that it is now possible to take note of relatively final results. These results give some insight into the problem of the relative effectiveness of these two methods, but perhaps still more into the statistical magnitude of the work which remains before any really final settlement of this controversy can be reached.

Before reporting these results, reference must be made to the most pertinent evidence now available as to the relative value

* This study was set up and the cases treated in 1945 and 1946 when both authors were members of the gynecological staff of the Memorial Hospital. The authors wish to acknowledge the courtesy of Dr. Alexander Brunschwig, the present head of the Gynecological Division at Memorial Hospital, for his permission to use the records, and to point out that he is responsible neither for the original treatment of these cases nor for the opinions expressed in this article.
† Presented at the Thirty-fourth Annual Meeting, American Radium Society, Chicago, Ill., June 8–10, 1952.

Fig. 1. Cervix of a patient who originally had a friable granular papillary carcinoma, after four treatments of 500 r each with an intravaginal cone. The area which does not stain black with Lugol's solution is intraepithelial carcinoma. All the infiltrative tumor had disappeared suggesting that it was more radiosensitive than was the intraepithelial carcinoma.

of these two plans of therapy for cancer of the cervix.

The Results of Radical Hysterectomy as Reported in the Older Literature. The classical method of performing a radical hysterectomy for cancer of the cervix was developed by Wertheim[25] who first described his procedure in 1900. Twelve years later he published the results of 250 patients treated by his operation more than five years previously.[26] These had been selected from a total group of 607 patients who presented themselves for treatment, giving an operability rate of 41 per cent. There had been 63 deaths from operation, an operative mortality of 25 per cent. One hundred and six patients survived five years, giving a cure rate of 42.4 per cent for the surgically treated cases, or, if the patients dying of intercurrent illness be subtracted, 42.9 per cent. Since all of the cases not operated upon would in those days have certainly died, the five year cure rate of all cases coming to the clinic was only 18.4 per cent.

Victor Bonney,[2] long known as the most eminent proponent of radical surgery for cancer of the cervix in England, reported in 1935 the five year end results in 384 patients. His operability rate was 63 per cent of all cases coming to the clinic and his immediate mortality, 14.3 per cent. The five year survival rate for the surgically treated cases was 39 per cent. Using his operability rate and a somewhat hypothetical formula for calculation he estimated his gross survival rate at 25 per cent.

In this country Morton[19] has reported Lynch's experience with radical hysterectomy on 88 cases. The operability was 10 per cent, the operative mortality 5 per cent, and the cure rate 64.7 per cent alive at five years. The absolute cure rate of this series cannot be calculated because of the extreme selection of cases.

The superiority of radiation methods at first appears evident when these calculated gross cure rates for surgery are compared with the results obtained by radiation therapy, as collected and published by Heyman[8] in 1948. In this report, the fifth of the series issued originally under the League of Nations Health Organization, a total of 30,299 cases collected from eight different countries and treated in twenty-four different radiotherapeutic centers were reported. Of these, 9,830, or 32.4 per cent, were alive at five years. If the 720 women who died of intercurrent disease be subtracted a corrected figure of 33.2 per cent is arrived at. If one notes also that the five year cure rate of patients treated in the ten largest centers varied from 29.4 per cent to 42.7 per cent it appears that from the statistical point of view radiotherapy was more effective than radical surgery done by the most experienced surgeons.

Several points, however, indicate that this conclusion is not actually self-evident. In the gross cures, rates calculated from the surgical cures and operability rates, no allowance is made for the few survivors that would have resulted from the irradiated Stage III and Stage IV cases regarded as unsatisfactory for surgery. Furthermore, the surgical statistics date from a decade, or even two, earlier than the radiation series which benefit by the earlier cases brought to the clinics by the constant educational campaigns. Finally, there are at least two reports, those of Adler[1] and of Köhler and Haenisch,[13] showing excellent results from combining radical surgery with radiation therapy.

Adler's procedure was that of radical vaginal hysterectomy with the insertion of a 50 mg. capsule of radium into each parametrium for six to eight hours, followed by external roentgen therapy. His absolute cure rate was 39 per cent. The second series to be noted is that of Köhler and Haenisch who report 582 cases of cancer of the cervix treated in the Hamburg Clinic between 1927 and 1938, with an operability rate of 54.1 per cent. All but 40 of the 315 patients operated upon were subsequently given intensive roentgen therapy. The unoperated cases were treated by intracavitary radium and roentgen rays. The over-all five year cure rate was 42.6 per cent, a figure equaled only twice among the radiation clinics giving statistics in the Heyman report,[8] namely that of Copenhagen (42.7 per cent) and of Norway (41.7 per cent).

The Revival of Radical Surgery for Cancer of the Cervix. In 1940 there was general agreement in the United States that radical surgery had little or no place in the treatment of cancer of the cervix because even in the most skillful hands the operative mortality was high and the five year survival rate certainly no higher than could be obtained by radiation therapy. This view, however, was not held universally since in Germany and Austria radical surgery continued to be used extensively.

Beginning in 1939, Meigs, stimulated by visits to Philipp and Warnekros in Germany, and by the work of Taussig on the dissection of pelvic lymph nodes, began to carry out radical hysterectomy on selected cases. At first these were women who had persistent but limited cancer after full irradiation. Shortly, however, he was operating on early primary untreated cases. By 1946, Meigs[17] had completed his one hundredth radical hysterectomy, without a single operative fatality.

Since Meigs' first report, there has been a tremendous renewal of interest in radical hysterectomy although the time is still too short to have permitted more than a few preliminary reports. Masson[15] has reported 55 cases done at the Mayo Clinic between 1943 and 1946, with only 1 operative death. Counseller[6] says that 130 cases were done in the same clinic without a death. Brunschwig[3] reports 225 cases operated upon at the Memorial Hospital, with only 1 death, though in a discussion[4] of Meigs' paper he changes this to 2 deaths in 240 hysterectomies. Kelso[12] reports 62 patients treated by radium four weeks before radical hysterectomy, with 1 postoperative fatality. Donnelly and Caldwell[7] did 25 similar cases

TABLE I

CANCER OF THE CERVIX UTERI. RESULTS OF CASES TREATED WITH ROENTGEN THERAPY AND RADICAL SURGERY VERSUS CASES TREATED WITH ROENTGEN THERAPY AND RADON

Group A (Intended for surgery)		
Total number of cases		43
Apparently free of cancer at 5 years		24
Alive with cancer at 5 years		1
Dying of other than cancer of the cervix before 5 years		3
5 year cure rate	24/40	60%
I. Cases actually undergoing radical surgery		29
Apparently free of cancer at 5 years		22
Alive with cancer at 5 years		1
Dying of other than cancer of the cervix before 5 years		1
5 year cure rate	22/28	79%
II. Cases unsuitable for radical surgery		14
Apparently free of cancer at 5 years		2
Dying of other than cancer of the cervix before 5 years		2
5 year cure rate	2/12	16.7%
Group B (Intended for irradiation only)		
Total number of cases		44
Apparently free of cancer at 5 years		30
Alive with cancer at 5 years		1
Dying of other than cancer of the cervix before 5 years		2
5 year cure rate	30/42	71%

with 1 death. Schlink[21] says that in Australia there have been no postoperative deaths since 1945 in some 500 cases, "due possibly to the use of blood transfusions, antibiotics and anticoagulants." Cases of radical hysterectomy done by us or under our control now number 135, with 1 postoperative death on the fifth day from status asthmaticus.

One may conclude, then, from recent experience, that the formidable mortality confronting the surgeon who attempts radical hysterectomy is a thing of the past. Not only can he get his patient off the table and out of the hospital alive, but there is no necessity for him to hurry in the operating room. Since the time is no longer strictly limited, one can take great care to do a thorough, gentle block dissection, which perhaps is so different from the original operation as to make the results reported for these quite outdated.

The only five year figures published in detail so far with recent surgical techniques are those of Meigs.[18] He reports 57 League of Nations Stage I cases, of whom 46, or 80.7 per cent, are living at five years, and 28 League of Nations Stage II cases, of whom 17, or 60.7 per cent, are alive at five years. These survival rates are much better than have usually been reported for radium and roentgen therapy. In the Annual Report on the Results of Radiotherapy in Cancer of the Uterine Cervix,[8] the fifth volume collated in 1948 from twenty-four clinics, the relative five year cure rate is given as 62.5 per cent for Stage I, and 46.8 per cent for Stage II. After studying all the reports in the fifth[8] and sixth volumes,[9] one finds that Meigs' five year cure rate for Stage I carcinoma of 80.7 per cent has been equaled or surpassed by the principal radiotherapeutic institutes only six times since these statistics were first compiled in 1936. Mademoiselle Baud, from the Institut du Radium of the University of Paris, reports 13 of 16 patients seen in 1933 alive in 1938, or 81.3 per cent, and 28 of 34 patients seen in 1942 alive in 1947, or 82.4 per cent. Heyman, at the Radiumhemmet, found 14 of 16 patients treated in 1935 alive at five years, or 87.5 per cent. Waterman, in Providence, reports 13 of 16 patients seen in 1942 alive at five years, or 81.3 per cent. In 1941, at the Holt Radium Institute in Manchester, 15 of 18 patients were apparently cured, a survival rate of 83.3 per cent, while the same year 15 of 17 patients were treated successfully at the Marie Curie Hospital in London, giving a survival rate of 88.2 per cent.

These figures are quoted in some detail, for they emphasize that such an accomplishment is not a consistent one, but only occurs with small numbers of cases and probably by chance. No radiotherapeutic clinic can show as many consecutive early cases as Meigs with as good a five year survival rate for this stage of case.

Does this really show that surgery is superior to radiotherapy in treating early cervical cancer, or is it merely an indication

of Meigs' success in picking the most favorable cases? It seems to us that until comparative groups are studied in the same clinic this question cannot be answered with any degree of assurance.

Clinical Material and Methods of Management. From February, 1945, and for about eighteen months, all primary untreated cases of carcinoma of the cervix coming to the Memorial Hospital Clinic were submitted to one or the other of us for examination. The findings were described in detail, and diagrams were drawn to indicate the extent of the disease. The case was then placed in a stage of extension according to the International system of classification, as described in the Atlas published by the League of Nations Health Organization.[14] All cases of Stage I and II were then taken for the study and the cases of each of these stages, assigned in alternation into Therapeutic Group A or B. Thus two lists of patients were set up, each containing the same number of early and moderately advanced cancers. No intraepithelial carcinomas were included, nor were those who appeared on first examination to be classifiable in Stages III and IV.

By June, 1946, Group A contained 46 names and Group B, 45. Of these, 3 patients in Group A and 1 in Group B never returneds for treatment. The final lists then consist of 43 patients in Group A, of whom 14 were classified as Stage I, and 29 as Stage II; and 44 patients in Group B, of whom 13 were Stage I, and 31 Stage II.

The Group A cases were assigned to surgery. The technique of radical hysterectomy[24] was that now commonly employed, beginning with a lymph node dissection and proceeding to the removal of the uterus, parametria and a cuff of vagina. Because the Memorial Hospital had long depended on radiation for the treatment of cervical cancer, there was some prejudice against a procedure omitting radiation entirely. Consequently in the belief that it would diminish the danger of infection, Group A cases received intravaginal cone roentgen therapy in four doses of 500 r each to the cervix before radical hysterectomy. Following hysterectomy, the patients were given external pelvic roentgen therapy, either through six 11 by 14 cm. ports, or through four ports, the anterior and posterior ones being large (14 by 29 cm.) split fields. The factors were 250 kv., 70 cm. target skin distance, 1.5 mm. Cu, half-value layer equals 2 mm. Cu, 250 r as measured in air daily to each of two ports, total dose 2,000 r per port. In addition, four treatments of 750 r each were given through a vaginal cone,[23] the factors being 130 kv., 25 cm. target skin distance, 0.1 mm. brass plus 0.25 mm. Al filtration, 5.2 mm. Al half-value layer.

The Group B cases were treated by radiation alone. The external therapy was as outlined above with, however, the addition of intravaginal cone treatments. The latter amounted to 750 r for each treatment and the total was usually 4,500 r to each of three intravaginal ports. As soon as the external and intravaginal roentgen therapy had been completed, the patient was admitted to the ward, and a cervical radon applicator inserted in the canal. These applicators were designed to be as long as the canal. They contained radon filtered by 0.5 mm. of platinum, and were made of a plastic 1 mm. in thickness. The radon was unevenly distributed along the applicator, usually being twice as strong at the base as at the tip. The total amount of radon used was high, over 100 mc., so that the treatment, 3,000 mc. hr., was of the high intensity, short duration type. The radon application usually lasted twenty to thirty hours.

These two groups, then, demonstrate contrasts, not between surgery alone and an irradiation technique, but between the effect of a radon tandem and of radical surgery, in patients receiving external and intravaginal roentgen therapy.

Emphasis must also be made of the point that the 43 cases assigned by the system of alternation to surgery could not all be operated upon. It was the intent to set up two groups of patients as nearly

identical as possible and to allow surgery to carry as an inherent deficit those cases in which surgery was at that time considered unfeasible or inadvisable. Fourteen of the patients of Group A were not operated upon for the following reasons: excessive obesity, 4; hypertension or other medical contraindications, 3; progress of disease before admission or reclassification as Stage III, 3; found to be inoperable at time of exploration, 3; records missing, 1. All 14 of the patients in the surgical group not treated by radical hysterectomy received complete roentgen and radon therapy. There were thus 29 patients (67.5 per cent) who actually underwent a radical hysterectomy (operability rate of all cases coming to the clinic approximately 44 per cent).

All 88 patients have been followed for five years or until death. In most patients the follow-up has been based on Memorial Hospital Clinic visits, but a few patients have been reached simply by letter or telephone.

Results of Treatment in the Two Series. Of the 43 patients in Group A (the surgical series) 25, or 58 per cent, were living at five years, one after a recurrent cancer had been treated at about the end of this period by pelvic exenteration. Of the 18 patients who were dead, 1 had died of cerebral hemorrhage, 1 of chronic myocarditis and 1 from carcinoma of the breast. If these patients dying of intercurrent disease are subtracted there remain 24 of 40 patients living and apparently free of cancer at five years, or 60 per cent.

Of the 44 patients in Group B (the radiation series) 31 patients, or 70.4 per cent, were alive at five years. One of these has since died and presumably had cancer at the five year mark. Of the 13 patients who died before five years, one succumbed to a cardiovascular accident and another to intestinal obstruction following a volvulus. If these latter are subtracted as indeterminate cases we have 30 of 42 patients living and well at five years, or 71 per cent.

The cases of Group A must also be divided into two groups. These are:

I. Twenty-nine patients actually operated upon, of whom 23, or 79 per cent, were alive at five years. Of the 6 dead patients, 1 had died of breast cancer. Of those living, 1 had a persistent cancer of the cervix. With subtraction of the patient who died of breast cancer, the final figures are 22 of 28 (79 per cent) living and free of disease; 23 of 28 (82 per cent) alive at five years.

II. Fourteen patients in Group A on which no operation was done and treatment was by irradiation alone, of whom there were only 2 survivors. Ten had died of cancer and 2 of intercurrent disease.

Certain other points need to be mentioned in relation to the end results, in particular the incidence of injury or complications. In this surgical series there were no vesical or ureteral fistulas, the only recorded complication being a case of bilateral fracture of the neck of the femur following the external irradiation. In the Group B cases there were 7 cases with radiation proctitis, 1 progressing to fistula and 1 to stricture; 6 with severe cystitis, 2 developing ulceration and 1 a vesicovaginal fistula; 2 with hip fractures. In this series the incidence of complications from irradiation were therefore higher than from surgery.

Note should be made of the fact that lymph nodes were found involved in 5 of the 29 cases treated by radical surgery (17 per cent). Of these 5, there are still alive 2 free of disease and a third living after a pelvic exenteration.

An important effect of the vaginal cone irradiation was noted on 5 of the surgically treated cases of Group A. In these 5 cases, all of whose original biopsies showed typical infiltrating carcinoma, there remained in the surgical specimens after four treatments of 500 r each, little or nothing of the original lesion, except intraepithelial carcinoma. So far as we are aware, this is the only published observation that has been made showing that intraepithelial carcinoma may be much more radioresistant than infiltrating carcinoma. This observation, an incidental one in this study, may

explain the deaths of at least 2 patients treated by us with full radium treatment for intraepithelial carcinoma, but who died several years later of widespread infiltrative cancer.

DISCUSSION

The figures derived from the study of these 87 patients with Stage I and Stage II cancer of the cervix indicate that there was a 71 per cent cure rate in the series treated by irradiation alone and 60 per cent in the surgical series in which radical hysterectomy was done when not specifically contraindicated.

With this number of cases, although it involved nearly two years of work in a large clinic, the difference between 60 per cent and 71 per cent is not statistically significant. It has been estimated by our statistical consultant, Dr. John Fertig, that a series five or six times as large would be needed before a difference of this degree would demonstrate conclusively the superiority of irradiation methods.

It is interesting to note that the best results of all were obtained in the subgroup of the A series, who actually underwent radical hysterectomy. Here, the cure rate, after deduction of patients dying of intercurrent disease was 79 per cent. This is a very high figure for a group containing Stage I and Stage II cases. Such a series demonstrates what excellent figures can be produced in surgical series when cases are carefully selected.

The worst results were among the cases of Group A, excluded from surgical therapy, and treated by irradiation alone. Here there were only 2 survivors and 10 deaths from cancer, a cure rate of 16.7 per cent. It is evident that cases unsuitable for surgery will do badly by radiation therapy.

It is probable that a similar number of cases with a poor outlook were present among the 44 cases of Group B, but this was not apparent, because the final test of operability was not applied. If we could remove 14 cases from this group of whom 10 died as we did with Group A, the survival rate would be 27 out of 30, or 90 per cent.

CONCLUSIONS

1. The literature based on the reports of the results of different techniques for therapy, in cancer of the cervix uteri, as carried out in different institutions and at different times, does not give statistics upon which a decision between surgical and radiation therapy can be based.

2. A carefully controlled study in which alternately assigned cases are simultaneously treated in the same institution by the methods to be compared seems necessary to arrive at such a decision.

3. In a series of 29 cases treated by preoperative roentgen therapy, radical surgery and postoperative irradiation, 22, or 79 per cent, were free of disease at five years. However, these patients represent a selected group. If one adds to them 14 cases in which a similar form of treatment was planned but not carried out because of obesity, hypertension, rapid extension of disease, or metastatic disease as discovered at exploratory laparotomy, who subsequently received radium instead of having radical hysterectomy, only 60 per cent of the group were living and free of disease at five years.

4. To be compared with the above are a group of alternate cases who received all their treatment by external and intravaginal roentgen therapy and by intrauterine radon. Of these, 30 of 42 were living apparently free of disease at five years, or 71 per cent.

5. These figures, 60 per cent and 71 per cent, while they may well be meaningful in suggesting that radiation therapy is a more effective agent in treating cancer of the cervix uteri than is a combination of irradiation and radical surgery, are not statistically significant in such small groups.

6. Selected cases treated by surgery cannot be compared fairly with unselected cases treated by irradiation.

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Vol. 71, No. 3

THE SYNERGISTIC EFFECTS OF ROENTGEN RADIATION AND CORTISONE UPON SUSCEPTIBILITY OF MICE TO PATHOGENIC MICROORGANISMS*

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WHOLE body roentgen irradiation acts to render the experimental animal susceptible to infection by microorganisms contained within its gastrointestinal tract, within its environment, or introduced experimentally. Cortisone, when employed singly, will act similarly to make the host susceptible to a variety of microorganisms. It has been learned in studies from our group already reported[4,6,17,23,27,28] and underway that cortisone and roentgen radiation used in combination operate synergistically to alter host resistance to infection by a wide range of microbial agents and to the transmissibility of cells of mouse leukemia, line I_b.

The purpose of this paper is to present the findings of experimental studies which delineate and yield information concerning the effects of roentgen radiation and cortisone upon the susceptibility of the host to microorganisms and leukemia tissue transplants. The effects of roentgen radiation alone in this field were studied as early as 1914 by J. B. Murphy *et al.*[14,15,16] Later Zinsser and Ruiz Castaneda[29] utilized roentgen irradiation of rats as a means for obtaining large numbers of *Rickettsia prowazeki*. An excellent review on the variable effects of roentgen radiation on infections and immunity was recently published by Taliaferro and Taliaferro.[24] Cortisone, when employed singly, has been reported to increase the severity of infections by any of a variable group of infectious agents. The use of cortisone singly to enhance infections with viruses, bacteria, and a single fungus has been recently reported.[1,5,7–9,13,19–22,25,26]

METHODS

The test animals were given total body roentgen irradiation in a range from 50 to 500 roentgens, as a single dose more commonly twenty-four hours before the injection of a pathogenic microorganism. The irradiation factors were as follows: 250 kv. (peak); 15 ma., filter 0.5 mm. of copper, 1 mm. of aluminum; half-value layer 1.35 mm. of copper; 60 cm. target skin distance. The size of the field was 14 cm. in diameter. The output was 41.5 r per minute in air.

Cortisone acetate (Cortone—Merck) in amounts that ranged from 0.35 milligram to 7.5 mg. was injected subcutaneously as a single dose two hours prior to the injection of the pathogen. However, in an experiment that dealt with transmissibility of line I_b leukemia, 0.05 mg. was administered in seven successive daily doses for a total of 0.35 mg. Finally, the test microorganism, or the leukemic cell transplant, was employed for the injection of test animals. The animals were kept under observation for thirty days to note any adverse effects as shown by weight loss, death of the host, histological change and evidence for the spread of the microorganism. Suitable controls were utilized routinely.

The microorganisms employed were two fungi, *Blastomyces dermatitidis* and *Candida albicans;* two viruses, Coxsackie virus, group A, type 4, Minnesota 1 strain, and poliomyelitis virus, type 2, Lansing strain. *Mycobacterium tuberculosis* is also being studied, but experiments are not yet fully completed for reporting. Line I_b leukemia originated spontaneously in an inbred strain of mice which was designated as

* Presented at the Fifty-third Annual Meeting, American Roentgen Ray Society, Houston, Texas, Sept. 23–26, 1952.

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The work described in this paper has been supported in part by a research grant from the Division of Research Grants and Fellowships of the National Institutes of Health, United States Public Health Service.

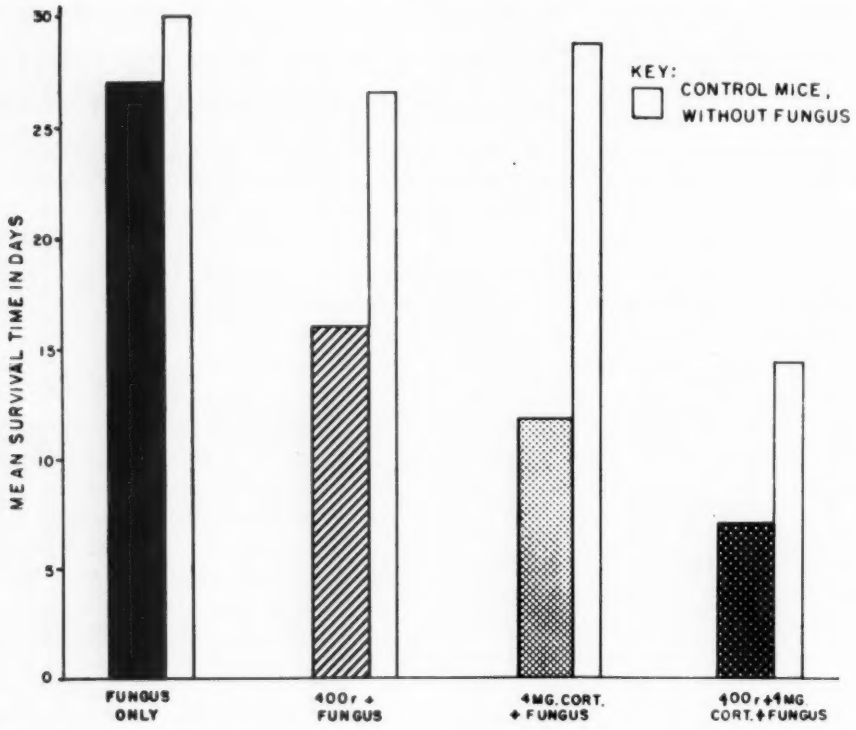

FIG. 1. The synergistic effect of cortisone and roentgen radiation upon experimental blastomycosis.

C_{58}, and maintained by Dr. E. C. MacDowell.*

In earlier experiments, the pretreatment with roentgen radiation was administered twenty-four hours and the cortisone was injected two hours before the inoculation of the pathogenic microorganism. Later experiments demonstrated optimal effects of the enhancing phenomenon when irradiation was administered ninety-six hours and cortisone twenty-four hours prior to the inoculation of one microorganism tested, *Candida albicans*.

RESULTS OF EXPERIMENTS

Blastomyces dermatitidis. Two hundred and forty adult Swiss albino mice, CFW strain, were employed in ten groups of 24 mice as test and control animals. Each group of test mice received 200 r, or 400 r, of total body irradiation, and/or cortisone in a dose of 2, 4, 6, or 7.5 mg. injected subcutaneously twenty-four hours later, and, finally, by intraperitoneal injection two hours later 1.0 ml. of a 1:150 suspension of a five day old yeast phase culture of *Blastomyces dermatitidis*. The animals were observed for thirty days. The results of the experiments are demonstrated in Figure 1.

The employment of 400 r of roentgen radiation and cortisone prior to inoculation of the test animals with *Blastomyces dermatitidis* resulted in a remarkable enhancement of susceptibility of test mice to the fungus. All 24 animals died within fifteen days with a mean survival time of 7.6 days. Most of the animals died within the first week of disseminated fungus infection. These findings may be compared with the group of animals that received the fungus alone, in which 20 of the 24 animals survived for thirty days, and 22 of the 24 survived for fifteen days (mean survival time of 27 days). In none of these animals was there a widespread dissemination of the lesions of blastomycosis. The group of animals that had received roentgen irradiation, 400 r, and fungus showed a greater susceptibility to the fungus than the nonirradiated group as shown by 18 survivors in thirty days; or 21 survivors in fifteen days (mean survival time of 16.1 days). The animals that had received 4 mg. of cortisone and the fungus succumbed slightly more rapidly (mean survival time of 12.1 days) than the mice that had been

* We are indebted to Dr. E. C. MacDowell for the use of this line of leukemia.

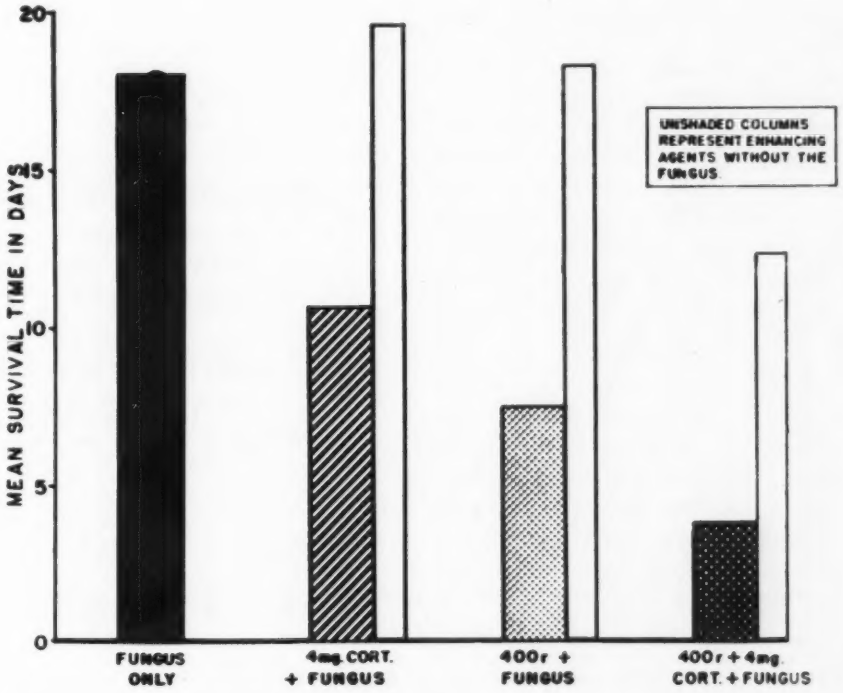

FIG. 2. The synergistic effect of cortisone and roentgen radiation upon experimental moniliasis.

given roentgen irradiation and fungus. The results of the comparable control group are demonstrated by the open bars.

Candida albicans. This fungus is slightly pathogenic for mice. It was selected for study because an animal host for this fungus is needed. Similar groups of mice of 24 each were utilized as test and control animals. Figure 2 depicts the mean survival time in several groups to demonstrate the enhancement of pathogenicity of *Candida albicans* for CFW mice when the host animal had been pretreated with roentgen irradiation and/or cortisone. The mean survival time for the 24 animals that were given 400 r of roentgen radiation and 4 mg. of cortisone and fungus is 3.8 days, as compared to eighteen days in the group of 24 animals that had received fungus alone, and 7.5 days for the animals that had received radiation and fungus, and 11.7 days for the recipients of cortisone alone. The comparable controls are demonstrated on the chart by open bars.

In this experiment (Fig. 3) the optimal time interval for pretreatment with roentgen radiation and cortisone was investigated. A slight enhancement in the fulminant nature of the infection when roentgen radiation was administered ninety-six hours and cortisone twenty-four hours prior to inoculation with fungus is suggested.

Coxsackie Virus. Coxsackie virus is infectious on transfer to newborn mice but not to adult mice. Large groups of CFW mice were conditioned with roentgen irradiation, as already described, by the administration of from 50 to 400 r and/or cortisone within a dosage range of from 0.1 to 4.0 mg. A known quantity of virus of a filtrate prepared from a 10 per cent tissue suspension was inoculated.

Figure 4 summarizes some of the data to demonstrate the synergistic effects of cortisone and roentgen radiation on the pathogenicity of Coxsackie virus. The enhancive effect of radiation and cortisone on the LD_{50} is plotted for ten day end points and for thirty day end points. It was previously learned that the LD_{50} at thirty days required a dosage of 3.7 mg. of cortisone and virus and similarly for roentgen irradiation about 325 r and virus were required. However, when 50 r of radiation and virus were utilized it required only 1 mg. of cortisone in addition to produce the LD_{50}. Furthermore, when roentgen radiation, 150 r, and cortisone were administered, only 0.1 mg. of cortisone was required to produce the LD_{50}.

Cortisone and roentgen radiation, when em-

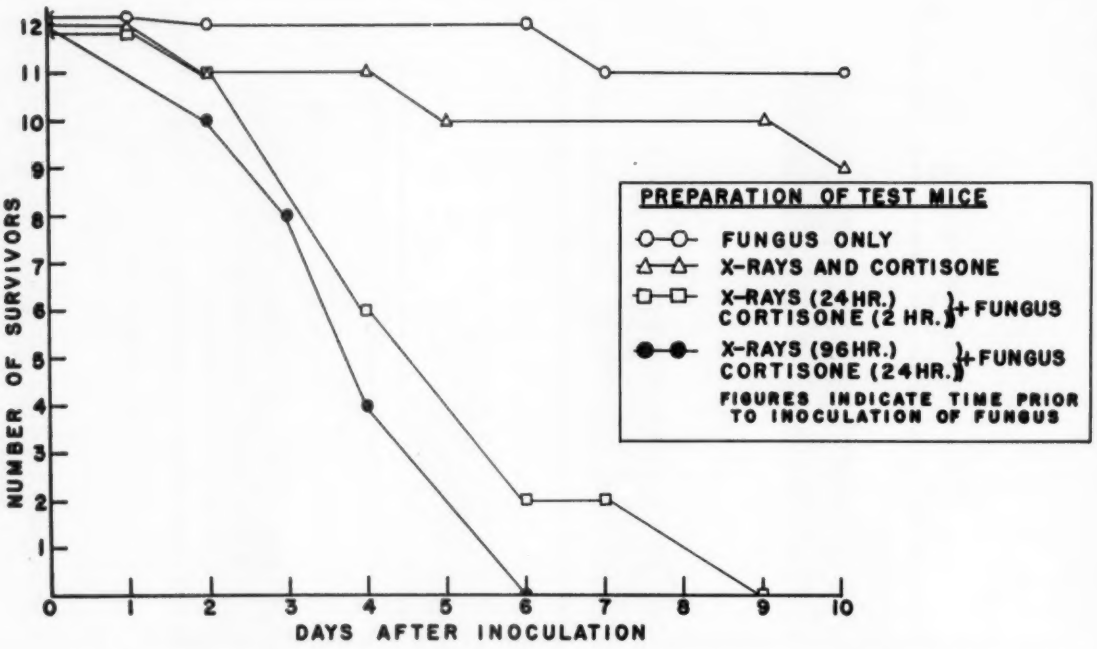
NUMBER OF SURVIVORS
DAYS AFTER INOCULATION
PREPARATION OF TEST MICE
FUNGUS ONLY
X-RAYS AND CORTISONE
X-RAYS (24HR.) CORTISONE (2 HR.) + FUNGUS
X-RAYS (96HR.) CORTISONE (24HR.) + FUNGUS
FIGURES INDICATE TIME PRIOR TO INOCULATION OF FUNGUS

FIG. 3. The comparative effects of time variation for pretreatment with roentgen radiation and cortisone for enhancement of the pathogenicity of *Candida albicans* for mice.

ployed in combination for the preparative treatment of an insusceptible host, the adult CFW mouse, operated synergistically to render the Coxsackie virus lethal.[6,23]

Another group of experiments was designed to learn whether the enhancive effect upon the pathogenicity of a Coxsackie virus that resulted from pretreatment with roentgen radiation and cortisone was operative when tested in animals which previously had been actively immunized

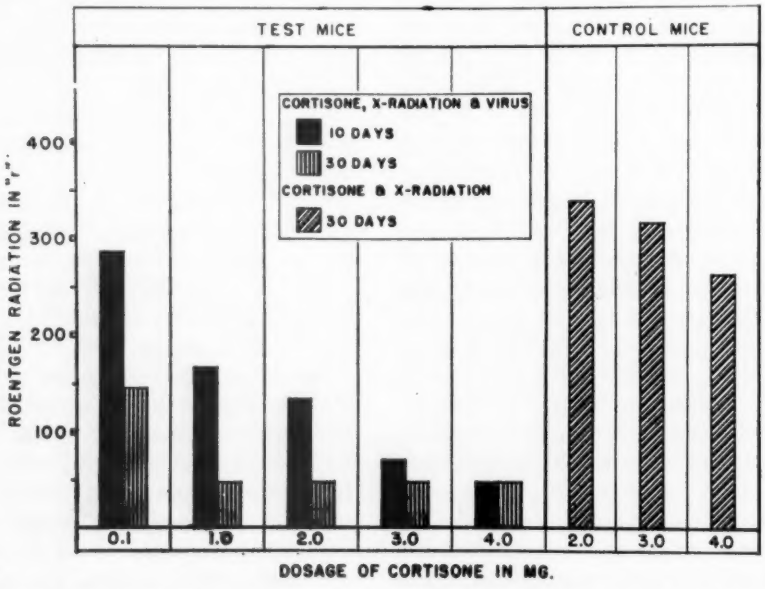

FIG. 4. The enhancing effect of cortisone and roentgen radiation on the pathogenicity of Coxsackie virus for resistant adult CFW mice as indicated by the LD_{50} value for a fixed dose of cortisone in combination with graded amount of roentgen radiation.

TABLE I

THE EFFECT OF ROENTGEN RADIATION AND CORTISONE UPON THE SUSCEPTIBILITY OF MICE TO COXSACKIE VIRUS WHEN PREVIOUSLY IMMUNIZED BY THE VIRUS

Treatment	Immunized Mice	Nonimmunized Mice
Pretreatment Cortisone—2.0 to 8.0 mg. Roentgen radiation —250 to 450 r Coxsackie virus	1/58–1.7%*	44/122–36%
Pretreatment only Cortisone—2.0 to 5.0 mg. Roentgen radiation —250 to 450 r	1/40–2.5%	4/135–2.2%

* Denominator signifies number of test mice; numerator number of dead mice.

by the virus. Table 1 shows the number of dead mice over the number treated in four large groups. It is seen for the group of mice previously actively immunized with Coxsackie virus and again pretreated with roentgen radiation and cortisone before challenge with another dose of Coxsackie virus that only 1 of 58 animals died (1.7 per cent). This percentage of deaths is representative of the findings for both sets of controls. However, in the group of mice which had not been immunized previously, or pretreated with roentgen radiation and cortisone, 44 of 122 succumbed to the infection (36 per cent). Thus, it is evident that the enhancing effect of cortisone and of roentgen radiation upon the pathogenicity of Coxsackie virus for normally insusceptible mice was not in evidence when the same mice had been previously actively immunized.

Poliomyelitis Virus, Lansing Strain. All test animals received 200 r of roentgen radiation and/or 2 mg. of cortisone prior to inoculation with 0.03 ml. of the centrifugate of 10 per cent mouse brain suspension from animals infected with the Lansing virus. The animals that received roentgen radiation and cortisone prior to inoculation with the virus demonstrated a 40 fold increase in LD_{50} titer of the virus titrated four weeks after the inoculation as compared to the controls receiving virus alone. Animals pretreated with roentgen radiation or cortisone singly showed an enhancive effect which was not as marked as for the roentgen radiation and cortisone group.

Homoiotransplantation of Mouse Leukemia, Line I_b. Line I_b lymphatic leukemia of spontaneous origin and regularly inoculable into the highly inbred strain of mice designated as C_{58} was utilized in this study. This line of leukemia is not transplantable in the inbred strains of mice which are designated Bagg albino, Strong A, and StoLi, or in the heterozygous strain, CFW Swiss albino. Figure 5 demonstrates the effects of cortisone and roentgen radiation employed singly and in combination on the susceptibility of three resistant strains of mice to leukemia line I_b. The untreated mice of all three strains which had been inoculated with leukemia cells survived uniformly. However, the transfer of line I_b leukemic cells to mice of the same three strains which had received treatment with 200 r and 2 mg. of cortisone, or 200 r and 0.35 mg. of cortisone, resulted in death from leukemia. This survival time in the groups that had received the larger dose of cortisone was shortened. The group of mice that was given 200 r of roentgen radiation and leukemic cells did not reveal the same uniform mortality but were highly susceptible. However, mice in other experiments that received at least 300 r uniformly succumbed to transmitted leukemia.

The group of animals that was given cortisone alone demonstrated a strain difference in susceptibility. The resistance of the StoLi and Swiss albino strains to the transplant was not decreased as greatly as was the resistance of the Bagg albino strain when 2 or 0.35 mg. of cortisone were employed.

The data for the StoLi strain serve to demonstrate the enhancive or synergistic effect of the combination of roentgen radiation and cortisone in this phenomenon. When 200 r of roentgen radiation alone were employed, 6 of 10 mice survived with a mean survival time of 15.5 days. When 0.35 mg. of cortisone was used, all mice survived. When the combination of 200 r and 0.35 mg. of cortisone was used in pretreatment, all mice succumbed to leukemia with the mean survival time accelerated to 4.1 days.

Further experiments were designed to evaluate the effect of this phenomenon on artificially induced active immunity. Figure 6 demonstrates in summary the effects of cortisone acetate and roentgen radiation employed (a) in combination and (b) independently upon the

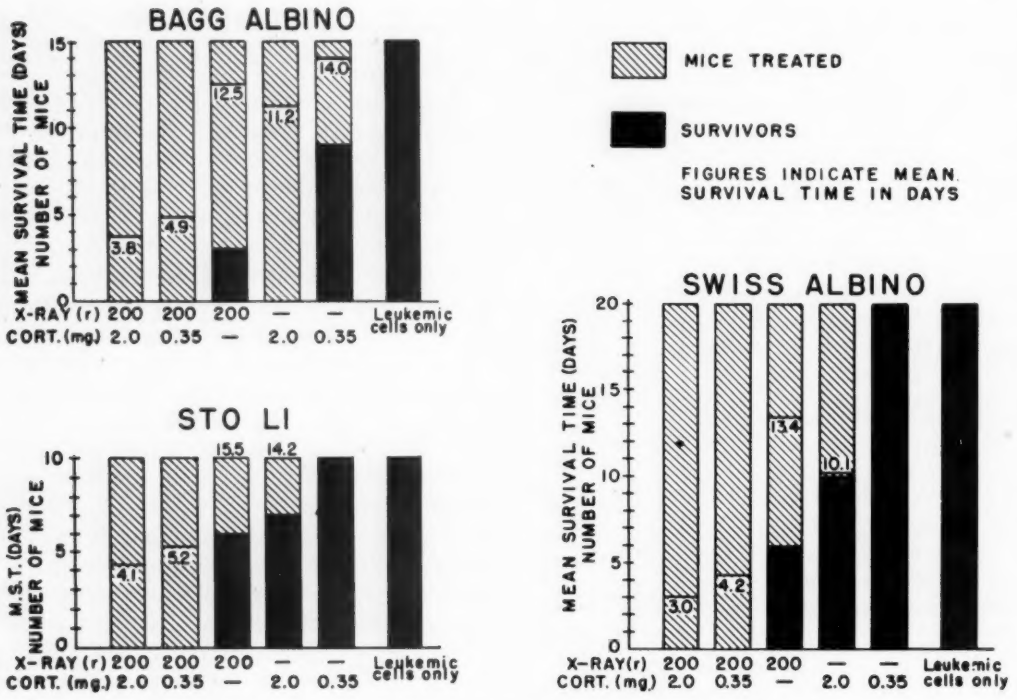

FIG. 5. The effects of cortisone acetate and roentgen radiation employed in combination and independently upon the susceptibility of three resistant strains of mice to mouse leukemia, line I_b.

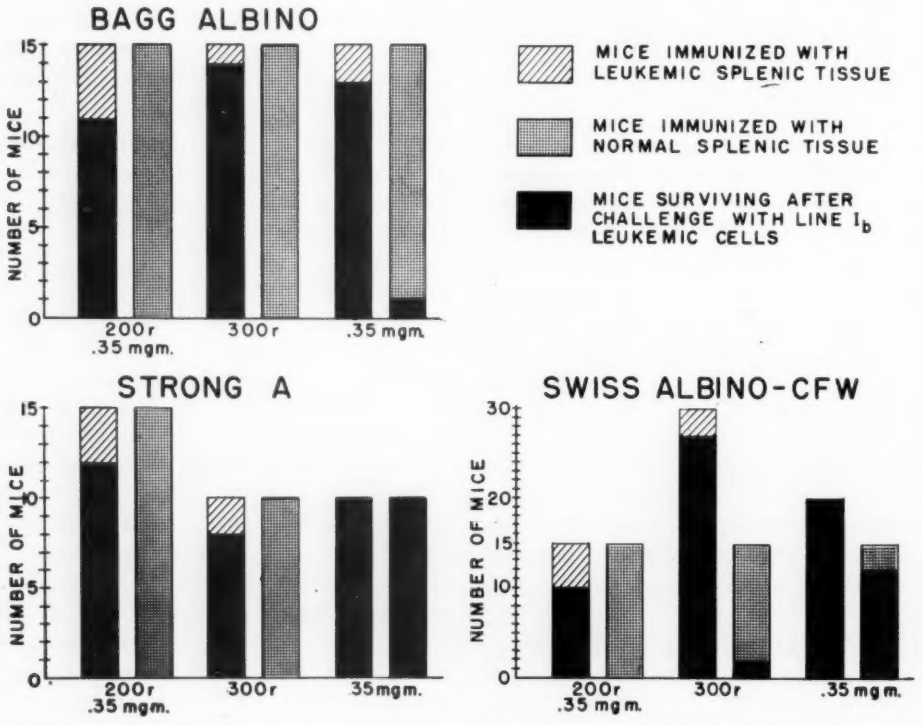

FIG. 6. The effects of cortisone acetate and roentgen radiation employed in combination and independently upon the susceptibility of three resistant strains of mice to mouse leukemia, line I_b, after previous immunization with homologous cells.

susceptibility to mouse leukemia line I_b of three resistant strains of mice which had been prepared by previous active immunization with homologous cells.

Groups of three resistant strains of mice (Bagg albino, Strong A, and CFW) were immunized over a three-week period by three weekly injections of line I_b leukemic tissue from C_{58} mice. Thus, an artificially induced immunity was superimposed on a natural innate resistance. A control group of mice received the same inoculation of splenic tissues from non-leukemic C_{58} mice. These six groups of mice were then treated with roentgen radiation and /or cortisone before challenge with leukemic cells. In Figure 6 are data which demonstrate that normal splenic tissue for immunization was without protective effect. The mice that had not been specifically immunized to leukemia succumbed upon pretreatment with roentgen radiation and cortisone. Furthermore, of the animals that were given pretreatment with roentgen radiation alone, 300 r, almost all succumbed to leukemic transplant. On the other hand, the strains of mice survived, which otherwise had been found to succumb to leukemic transplantation following pretreatment with roentgen radiation and/or cortisone, upon being actively immunized with leukemic cells.

DISCUSSION

The radiologist must be aware of and understand the biological effects of radiation, and should collaborate with investigators in allied fields of basic science. This investigation of the effects of roentgen radiation and cortisone upon the susceptibility of mice to pathogenic microorganisms and to leukemic transplants is an example of such cooperation between bacteriologists and immunologists and radiologists. Test animals and victims of total body radiation are adversely affected commonly in two manners: (1) by a deleterious effect on the hematopoietic system with the resultant decrease in cellular components of the circulating blood, and (b) by the effects of infection. The fulminant nature of infections in totally irradiated animals can partly be explained by the decrease in the blood cellular elements. However, more general factors such as specific immune response and the development of antibodies play an equally important role.[2,3,12]

Genetic constitution is the commonly accepted factor which influences the species susceptibility of animals to infections and which controls the transmissibility of tumor transplants.[10,11] For many years roentgen radiation has been one agent which is known to temporarily affect the species specificity in tumor transplants and to overcome resistance to microorganisms. Cortisone, as does ionizing radiation, has an adverse effect upon host resistance to many infections. This effect is manifest as an increase in severity of the infectious process and in death. The similarity in action of the two agents is that both result in an impairment of the inflammatory process and in a decrease in the production of antibodies. The two agents operate similarly in their ability to overcome the innate resistance of inbred and heterozygous groups of mice to inoculation with lymphoid leukemia, line I_b. Other differential factors in their action undoubtedly occur but as yet have not been determined. The use of roentgen radiation and cortisone in combination has resulted in an enhanced or synergistic effect on the breakdown of the natural innate resistance to infections and to tumor transplants.

The protection gained from the active immunization with specific antigens was not broken down by the alterative effects of roentgen radiation and cortisone. Mice previously actively immunized (1) by Coxsackie virus and (2) by line I_b leukemia cells, survived later pretreatment with roentgen radiation, cortisone and further challenge with the pathogen. It is therefore demonstrated for Coxsackie virus and the line I_b leukemia that pretreatment with ionizing radiation and cortisone will break down innate resistance while actively acquired immunity will remain unaltered.

SUMMARY

Roentgen radiation and cortisone operate synergistically in rendering test animals

susceptible to infection with the variety of microorganisms tested. Similarly, these agents operate to render three ordinarily resistant strains of mice susceptible to transmission of line I_b leukemia.

Roentgen radiation and cortisone used singly and in combination operate to greatest effect in the breakdown of natural innate resistance for the pathogens tested.

For Coxsackie virus and for line I_b leukemia actively acquired immunity affords protection for the test animal against the alterative effects of cortisone and roentgen radiation.

The potentiative effects of roentgen radiation and cortisone on infections have practical application in the laboratory study of various infectious agents of limited host receptivity. The marked acceleration in the development of infections and in the growth of microorganisms in animals pretreated with roentgen radiation and cortisone should increase accuracy and shorten diagnostic time considerably when thus utilized.

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DISCUSSION

DR. HAROLD TIVEY, Portland, Oregon. Dr. Friedman and his co-workers are to be congratulated for this interesting and comprehensive paper. This work is illustrative of the remarkable productivity of several disciplines of science working together as a research team.

I am certain Dr. Friedman does not intend that we apply his findings to patients treated with the usual therapeutic doses of either local roentgen radiation or cortisone. On a weight basis, 4 mg. of cortisone per mouse is of the order 25 times the usual therapeutic dose in man; 400 r of roentgen radiation is approximately two-thirds the median lethal dose in mice. These are "acute experiments" of a fundamental nature.

My own interest in statistical analysis has caused some disappointment in the presentation of results in this paper. May I suggest that survival data be represented as appropriate distributions. This will enable the ready calculation of significance of differences between the various groups of test animals.

The development of a test preparation from the roentgen and cortisone treated mouse for laboratory growth of a virus or fungus for which no really good host exists promises to be a useful laboratory tool.

The transplantation of mouse leukemia to a mostly insusceptible strain is certainly of importance. More important is the failure of such transplants to take in the mouse "immunized" by leukemic tissue, but not protected by normal tissue. To my knowledge this has not been previously accomplished for mouse leukemia.

This interesting paper provokes three questions:

(1) Can the leukemia in the cortisone and roentgen treated mouse be passed back to the original host strain, or can it be passed to other cortisone and roentgen treated mice?

(2) Do leukemic cells from other animals, especially man, "take" when injected into the cortisone and roentgen treated animals?

(3) Would Dr. Friedman care to comment on the etiologic implications as to the nature of mouse leukemia which may be raised by the phenomenon of "immunity" gained by injection of neoplastic tissues?

May I thank Drs. Martin and Friedman and co-authors for the privilege of studying and discussing this most interesting paper. I am sure we shall all look forward to seeing additional studies by Dr. Friedman's group.

DR. JAMES J. NICKSON, New York, New York. First may I remark on how pleasant and informative this meeting has been. It was extremely kind of you to invite me to participate.

Before passing on to detailed comments on Dr. Friedman's paper, a few general remarks might be in order. His paper represents the report of the class of study that is happily on the increase, namely, radiobiological investigations conducted by a radiologist, either alone or, as in this instance, in association with colleagues from other disciplines.

The clinical radiologist can contribute much to radiobiological work in that worthwhile problems suggest themselves from time to time

as a result of patient observation, that is, problems that are not likely to arise or to arise so soon in the minds of persons exclusively biologists.

The radiologist, in turn, will benefit by association with the experimentalist. First, the association will inevitably lead to a better acquaintance with radiobiological literature. This in turn may give him ideas for modifications in the management of patients under treatment.

Second, experience with experimental techniques and methods, I feel, will inevitably enrich the radiologist, and may lead to the design and execution of clinical investigations that would not otherwise suggest themselves.

Dr. Friedman and his associates have suggested a definite synergism of the combined injuries produced by ionizing radiation and cortisone in animals subsequently challenged with several kinds of noxious agents. Dr. Garrott Allen's work, and the work of others, has shown that animals in the postirradiation stage, placed under stress, do badly; that is, they die, and frequently will die more quickly than the controls.

It would be interesting, when Dr. Friedman and his associates present their histological and hematological data, to see whether in part radiation damage is responsible for the death of their animals. In a word, does the histological and hematological pattern suggest an enhancement of that class of damage, or is the mechanism of action simply more effective invasion by the organisms introduced.

The divergence of response, when natural or acquired immunity mechanisms are involved, supports the usually held theory that different mechanisms in the host are probably involved. It would be interesting to know whether the protection afforded by acquired immunity would hold in animals irradiated several weeks before the challenge infection was given. I have the feeling, based on observations earlier in the literature, that there at least would be a diminution in the protection given.

The suppression of native immunity to heterologous leukemia cells is of interest, and is supported by work done by Dr. Tulin and associates earlier this year. This may prove to be an effective way of culturing human neoplastic cells in animals. If so, the efforts of the experimentalists can be extended to cover human tumor cells growing in laboratory animals.

As Dr. Tivey mentioned, the implications of this work for the routine biological laboratory, as well as for the experimental biological laboratory, are obvious, and I shall not dwell upon them.

I would like to congratulate Dr. Friedman and his colleagues on an excellent piece of work, and I would like to express the hope that they will continue their efforts in this field.

Dr. Friedman (closing). I wish to thank Dr. Tivey and Dr. Nickson for their kind thoughts, and especially for their critical analysis of our paper.

In regard to Dr. Tivey's discussion, the dosages of cortisone, as used in these animal experimentations, are of course far out of the ordinary therapeutic range in humans. If we use 3 mg. of cortisone in a 30 gram animal, in a 70 kilogram animal the dose would be in the range of 7 or 8 grams of cortisone—and who can afford that as a single dose?

I am very appreciative of Dr. Tivey's suggestions about the redrawing of the survival curves, and the suggestions for the analysis of the material which is so adequately demonstrated in his exhibit on survival rates in the Scientific Exhibit.

The first question that Dr. Tivey has asked is, "Can leukemia be passed back into, first, the same or a susceptible strain of mice?" Second, "Can it be passed back into another set of previously irradiated mice?"

This was done almost routinely at the outset of the experiment. In these animals of resistant strains which developed leukemia, the presence of leukemia was demonstrated by histological change, size of the spleen, nodes, blood count, and cells were then transplanted into other C_{58} mice, and therefore they were able to continue the transmissibility of the line.

Dr. Tivey's second question is, "Do we have any experience with human leukemic cells?" We have purposely avoided any mention of the human, and there is no correlation of these experiments with any human application of the problem. We may undertake that as a later study, but we want to do the base work with the animals first.

Likewise Dr. Tivey asks if we have any knowledge as to the etiological agents of leukemia. Line I_b leukemia of McDowell from Cold Springs Harbor is a virus-free line. Dr. McDowell's line I had been contaminated with virus, and the line from which the virus was separated is labeled line I_b.

Dr. Nickson has asked about what histologi-

cal data and hematological damage we have found in the irradiated and infected mice. We have made histological study on the animals infected with the Coxsackie virus, with the fungi, and also with the leukemia. The abcesses of the fungi show a marked decrease in lymphocytes and the polymorphonuclear reaction. However, the absence of the cellular response is not the major factor in the enhancement of the pathogenicity, as is evidenced by the fact that this same principle should have applied in mice that were previously immunized. These previously immunized were protected in a manner that could not be explained by the cellular reaction of inflammation alone. On a small group of irradiated and affected animals we ran blood studies and found the usual hematological changes that have so frequently been reported in the literature that we thought it unnecessary to indicate it at this time.

I wish to thank the discussers for their interesting comments and the officers of the American Roentgen Ray Society for the privilege of giving this paper.

CASSETTE HOLDER FOR CHOLECYSTOGRAPHY IN RIGHT LATERAL DECUBITUS POSITION

By ANDREW TURNBULL, M.D.
VANCOUVER, BRITISH COLUMBIA

IN August, 1948, Kirklin[1] published a description of "A New Position for Cholecystography." In this article he reviewed the development of the technique for a lateral decubitus position for gallbladder examination. Some time later I visited Kirklin at the Mayo Clinic and obtained further details of the apparatus used. In attempting to set up equipment for a similar procedure it was discovered that the space in our roentgenographic rooms was not sufficient for the use of equipment as described by Kirklin. In addition, it was considered that the cost of an upright Bucky setup as used at the Mayo Clinic was somewhat prohibitive for private practice.

After trial it was found that very acceptable roentgenograms could be obtained by the use of the Camp grid-front cassette with the patient in the right lateral decubitus position, and it was necessary to construct a cassette holder for the Camp grid-front cassette to be used in positioning the patient. With the technical assistance of Mr. T. A. Gjernes, of the Picker X-Ray of Canada, Ltd., a cassette holder was constructed which allows for immobilization of the cassetts (Fig. 1). The cassette slides into a vertical holder which is fixed by the patient's weight on the base, the patient being placed on the right side on pillows or sandbags which raise the body above the table top to allow the tube to be lowered sufficiently so that the central roentgen-ray beam directed horizontally across the table clears the table top (Fig. 1). The holder also allows for elevating the cassette to varying levels above the table. The patient is placed on his right side with his abdomen in contact with the cassette (Fig. 2) and roentgenograms are made which are similar in technique to those described by Kirklin. We have not found it necessary to use an immobilizing compression band. From roentgenograms made in this manner we have been able to determine the presence of small nonopaque calculi which may layer (Fig. 3) or gravitate to the dependent portion of the gallbladder (Fig. 4) which are often impossible to visualize in the prone position. In our experience, we feel that the decubitus position is more satisfactory in

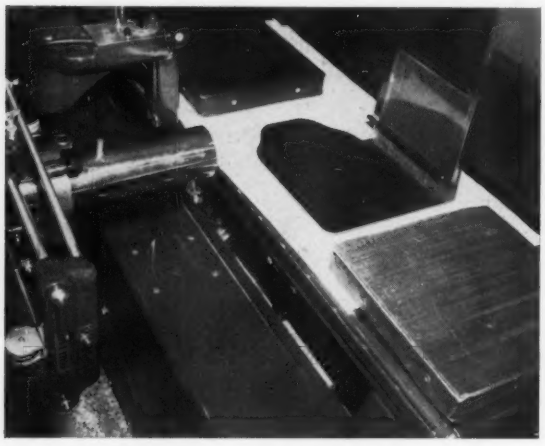

Fig. 1. Cassette holder in position, pillows separated to show base.

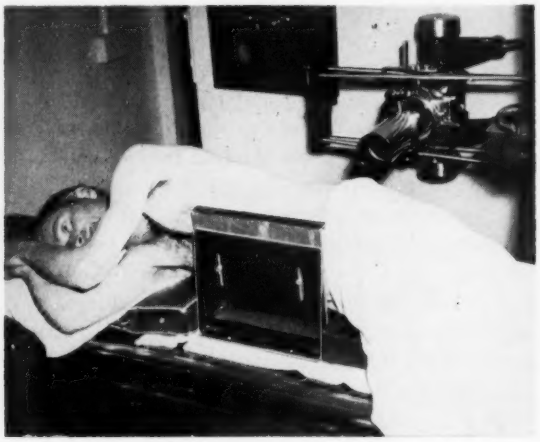

Fig. 2. Patient in position for decubitus cholecystogram.

FIG. 3. Decubitus cholecystogram showing layering of stones.

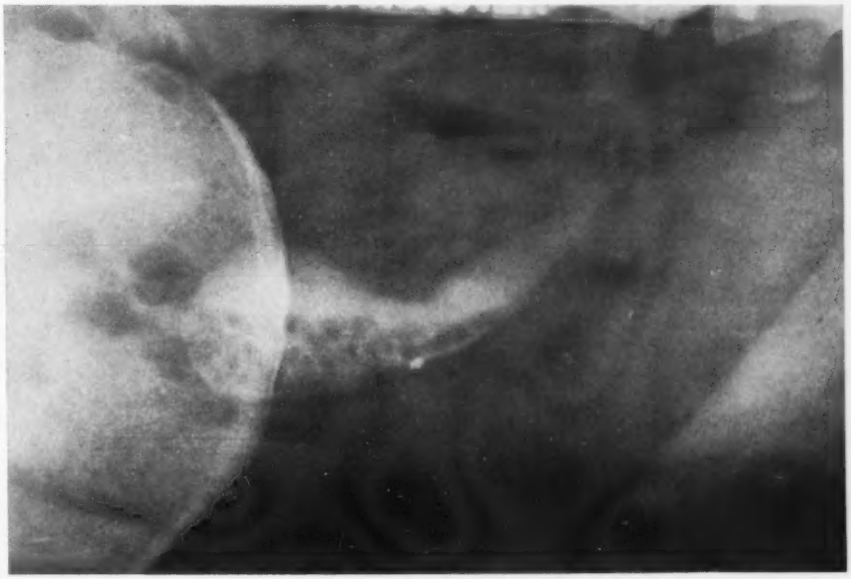

FIG. 4. Decubitus cholecystogram showing stones in dependent portion of gallbladder.

this regard than the upright as the gas tends to rise in the abdominal viscera and at the same time the gallbladder descends with the pull of gravity and the sag of the patient's abdomen between the elevating pillows, thus separating the shadows.

The average factors for roentgenograms in the decubitus position are 60–65 kv. (peak), 100 ma-sec., 42 inch distance. The tendency is to somewhat overexpose this view and should be avoided.

Andrew Turnbull, M.D.
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AN IMPROVEMENT FOR ROENTGEN-RAY FILM HANGERS*

By WALLACE S. TIRMAN, M.D.
BLUFFTON, INDIANA

THE roentgen film hanger which is in general use presents a disadvantage which can be overcome by the use of a handle. The purpose of this report is to demonstrate a film hanger to which a handle has been added. The latter is made from discarded frames. The joints can be soldered or welded. Figure 1 demonstrates the hanger with the addition of a handle on top. If the handles are placed accurately in the center of the frame a box-like type of recess can be added to the covers of the solution inserts where the handles protrude.

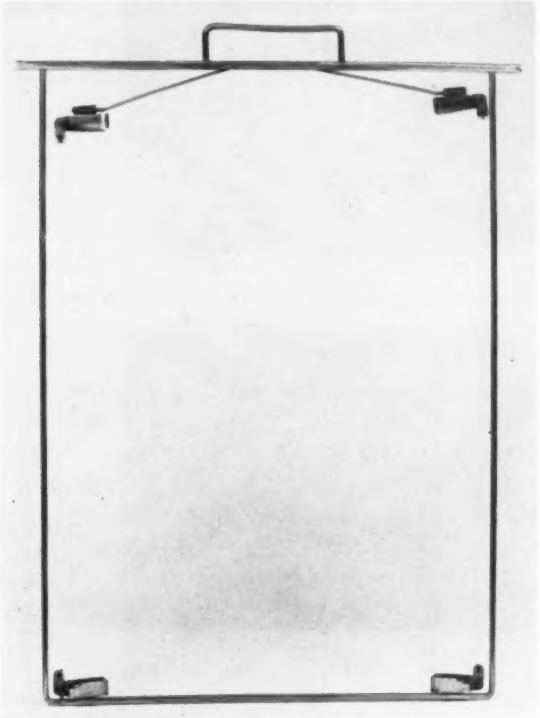

FIG. 1

This addition to the present form of roentgen film hanger presents several advantages. The handle permits the technician to move the hanger from one tank to another without wetting his hands with any of the solutions. This speeds dark room work, especially where the same technician works at the loading bench. The technician's hands can be more readily protected from silver stains and sensitivity reactions due to the solution.

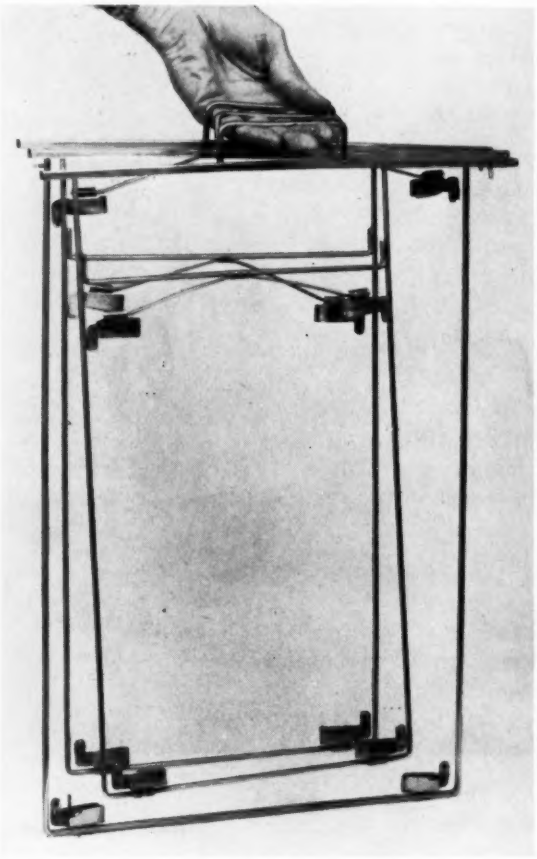

FIG. 2

Figure 2 demonstrates the ease with which several hangers can be handled simultaneously.

* From the Caylor-Nickel Clinic, Bluffton, Indiana.

Vol. 71, No. 3

THE AMERICAN JOURNAL OF ROENTGENOLOGY, RADIUM THERAPY AND NUCLEAR MEDICINE

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Published by: Charles C Thomas, Publisher, 301–327 East Lawrence Avenue, Springfield, Illinois.

Issued monthly. Annual subscription: United States, Mexico, Cuba, Central and South America, $15.00; Canada, $16.00; other countries, $17.00. Current single numbers, $1.50. Advertising rates submitted on application. Editorial office, 110 Professional Building, Detroit 1, Michigan. Office of publication, 301–327 East Lawrence Avenue, Springfield, Illinois. Information of interest to authors and readers will be found on page iv.

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EDITORIAL

THE ROENTGENOLOGIC SIGNIFICANCE OF FUNNEL CHEST

MASS roentgenographic chest surveys were originally initiated with the purpose of detecting pulmonary tuberculosis. As experience accumulated, however, it became evident that other intrathoracic lesions, the majority of them unsuspected, would also be encountered. Foremost among these are pulmonary and mediastinal new growths and various cardiovascular diseases or abnormalities. Less frequent conditions found include the anatomic deformities of the thoracic cage which may themselves produce rather marked changes in the intrathoracic structures. Among these deformities, of particular interest to the radiologist, is the funnel chest. Since photofluorograms usually are taken in the posteroanterior projection the funnel chest deformity itself may pass unrecognized, and the effects which it produces on the heart and lungs may be erroneously interpreted as manifestations of cardiac or pulmonary disease, often to the detriment of the patient. It, therefore, may not be out of place to briefly review these changes.

Funnel chest (pectus excavatum, Trichterbrust, sternal depression) is a deformity of the thorax in which the body of the sternum is depressed to form a concavity which may reach to the vertebral bodies, or pass to one side into either vertebral gutter. The effect of the sternal depression upon the lungs and mediastinal structures depends on the type and degree of the deformity. The lungs and heart are almost always involved by the malformation regardless of its degree; esophageal changes are not common and are of course not visualized on plain film studies.

From the roentgenologic standpoint, the most important are the cardiac findings. The alterations in contour of the heart elicited by the sternal depression have been recently re-emphasized by Edling.[1] The roentgenologic findings which he enumerates have been previously noted by various authors, more recently Evans,[2] Teplick and Drake,[3] Paul and Richter,[4] and others. In mild cases of funnel chest the heart is not displaced from its midline position, but merely pushed posteriorly by the impinging sternum. Decreased density of the central portion of the cardiac shadow with corresponding increased visibility of the spine and ribs through the heart results. Displacement of the heart either to the right or left occurs in most severe cases. Bodily displacement of the heart into the left hemithorax is usual. The displacement is ordinarily accompanied by rotation of the heart about its axes, particularly the vertical, and in the left anterior oblique projection the overlapping of the vertebral column by an apparently normal-sized heart is striking. Straightening of the left heart border and prominence of the main pulmonary artery segment may occur with or without displacement of the heart. This apparent "mitralization" of the cardiac contour can be falsely diagnosed as serious (mitral) heart disease.

Also of importance are the lung changes secondary to the funnel chest. Pressure of the retroposed sternum is demonstrated in some cases by a triangular area of increased density in the lower medial portion of the right lung due to compression of the underlying lung tissue by the sternum. This in-

[1] Edling, N. P. G. Radiologic appearances of the heart, oesophagus and lungs in funnel chest deformity. *Acta radiol.*, April, 1953, *39*, 273–280.

[2] Evans, W. Heart in sternal depression. *Brit. Heart J.*, 1946, *8*, 162–170.

[3] Teplick, J. G., and Drake, E. H. Roentgen and cardiac manifestations of funnel chest. AM. J. ROENTGENOL. & RAD. THERAPY, 1946, *56*, 721–735.

[4] Paul, L. W., and Richter, M. R. Funnel chest deformity and its recognition in posteroanterior roentgenograms of thorax. AM. J. ROENTGENOL. & RAD. THERAPY, 1941, *46*, 619–621.

creased density has been erroneously interpreted as pulmonary infiltration or consolidation. Edling[1] notes what he believes is a new sign. Ten of his sixty-six cases of funnel chest showed on chest roentgenograms diminution of the vascular markings in the lower portions of the lungs. Since variations in vascularity normally occur in these regions, the observation should be accepted with caution, as the author himself states.

In cases of severe funnel chest the barium-filled esophagus is seen to be displaced with the heart into either hemithorax. Edling observed the latter in only two of his cases.

The question arises whether the roentgenologic diagnosis of funnel chest is of any clinical significance or merely a problem of academic interest. To assert the clinical significance of funnel chest it is necessary to prove that it not only represents a severe anatomic defect which often leads in early life to psychologic disturbance, but that it does alter bodily function. There is some evidence that funnel chest can produce adverse effects upon the function of the cardiorespiratory system. Ravitch[5] reports a case in which heart failure ascribed to funnel chest was alleviated following surgical correction of the sternal deformity. A similar situation is described by Dorner, Keil and Schissel[6] who showed by angiocardiographic study marked enlargement of the right atrium and right ventricle and distortion of the tricuspid valve ring. The passage of the contrast medium through the right atrium was prolonged and filling of the right ventricle was delayed. Three weeks after plastic repair of the funnel chest a repeat angiocardiographic examination showed a more normal appearance of the chambers and satisfactory transit time through the right heart. Brown and Cook[7] performed a series of tests on their patients with funnel chest. Of the respiratory tests only the maximum breathing capacity was significantly altered from normal; this was beneficially increased about 31 per cent following operation. Electrocardiograms are often reported as abnormal in cases of funnel chest, but no characteristic feature in the tracing is known.

In view of the relative paucity of objective evidence of cardiac and pulmonary dysfunction associated with funnel chest, is surgical repair of the deformity indicated? One viewpoint of the matter has been recently presented by Bill,[8] who submitted a questionnaire as to the fate of adult patients with untreated funnel chest to a group of physicians and surgeons with wide experience in chest disease. Opinion from these experts was almost evenly divided as to what proportion of adults with severe funnel chest develop cardiac, pulmonary or psychologic disability; very few thought that the condition had any effect on the patient's life span, but almost all stated that a severe grade of funnel chest should be repaired in childhood. Many surgeons believe that the repair should be accomplished as soon as the deformity is manifest in the infant or child. Gross[9] has a more conservative attitude and recommends that the child attain the age of three or four years before decision on sternoplasty is made. Many infants with mild degrees of funnel chest which do not progress will thus be spared an operative ordeal.

The recognition of funnel chest deformity as evidenced on chest roentgenograms is, therefore, of importance. The radiologist who has the responsibility of interpreting chest films, especially photofluorograms, should be thoroughly familiar with the intrathoracic aberrations which funnel chest can produce. When funnel chest is suspected the radiologist should perform more extensive roentgen studies and, once the diagnosis is established, be prepared to discuss the significance of the findings.

Harold Fulton, M.D.

[5] Ravitch, M. M. Pectus excavatum and heart failure. *Surgery*, 1951, *30*, 178–194.

[6] Dorner, R. A., Keil, P. G., and Schissel, D. J. Pectus excavatum; case report with pre- and postoperative angiocardiographic studies. *J. Thoracic Surg.*, 1950, *20*, 444–453.

[7] Brown, A. L., and Cook, O. Cardio-respiratory studies in pre- and postoperative funnel chest (pectus excavatum). *Dis. of Chest*, 1951, *20*, 378–391.

[8] Bill, A. H., Jr. Funnel chest; indications for surgery and time of choice for operation. *Pediatrics*, June, 1953, *11*, 582–587.

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SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

American Roentgen Ray Society
Secretary, Dr. Barton R. Young, Germantown Hospital, Philadelphia 44, Pa. Annual meeting: Shoreham Hotel, Washington, D.C., Sept. 21–24, 1954.

American Radium Society
Secretary, Dr. R. E. Fricke, Mayo Clinic, Rochester, Minn. Annual meeting: The Homestead, Hot Springs, Virginia, March 14–16, 1954.

Radiological Society of North America
Secretary, Dr. D. S. Childs, 713 E. Genesee St., Syracuse 2, N. Y. Annual meeting: 1954, to be announced.

American College of Radiology
Executive Secretary, William C. Stronach, 20 N. Wacker Drive, Chicago 6, Illinois.

Section on Radiology, American Medical Association
Secretary, Dr. T. Leucutia, Harper Hospital, Detroit 1, Mich. Annual meeting: 1954, to be announced.

Fifth Inter-American Congress of Radiology
General Secretary, Dr. Eugene P. Pendergrass, 3400 Spruce St., Philadelphia 4, Pa. Meets at Shoreham Hotel, Washington, D. C., April 24–30, 1955.

Alabama Radiological Society
Secretary, Dr. J. A. Meadows, Jr., Medical Arts Bldg., Birmingham 5, Ala. Meets time and place Alabama State Medical Association.

Arizona Radiological Society
Secretary, Dr. R. Lee Foster, 507 Professional Bldg., Phoenix, Ariz. Two regular meetings a year. The annual meeting at time and place of State Medical Association and interim meeting six months later.

Arkansas Radiological Society
Secretary, Dr. Fred Hames, 511 National Bldg., Pine Bluff, Ark. Meets every three months and also at time and place of State Medical Association.

Atlanta Radiological Society
Secretary, Dr. Albert A. Rayle, Jr., 478 Peachtree St., N.E., Atlanta, Ga. Meets monthly, except during three summer months, on second Friday evening.

Brooklyn Roentgen Ray Society
Secretary, Dr. J. J. Daversa, 345 75th St., Brooklyn, N. Y. Meets monthly fourth Tuesday, October through April.

Buffalo Radiological Society
Secretary, Dr. Mario C. Gian, 610 Niagara St., Buffalo, N. Y. Meets second Monday evening each month, October to May inclusive.

Central New York Roentgen Ray Society
Secretary, Dr. Dwight V. Needham, 608 E. Genesee St., Syracuse N. Y. Meets January, May, November.

Central Ohio Radiological Society
Secretary, Dr. F. A. Riebel, 15 West Goodale St., Columbus, Ohio. Meets at 6:30 P.M. on second Thursday of October, December, February, April, and June at Columbus Athletic Club, Columbus, Ohio.

Chicago Roentgen Society
Secretary, Dr. Elbert K. Lewis, 6337 S. Harvard Ave., Chicago, Ill. Meets second Thursday of each month, October to April inclusive at the University Club.

Cleveland Radiological Society
Secretary, Dr. Mortimer Lubert, 10515 Carnegie Ave., Cleveland 6, Ohio. Meetings at 6:45 P.M. on fourth Monday of each month from October to April.

Colorado Radiological Society
Secretary, Dr. Parker Allen, Children's Hospital, Denver, Colo. Meets third Friday of each month at University of Colorado Medical Center or at Denver Athletic Club.

Connecticut Valley Radiologic Society
Secretary, Dr. E. W. Godfrey, 1676 Boulevard, West Hartford, Conn. Meets second Friday October and April.

Dallas-Fort Worth Roentgen Study Club
Secretary, Dr. O. H. Grunow, 650 Fifth Ave., Fort Worth, Texas. Meets monthly, third Monday, at Greater Fort Worth International Airport at 6:30 P.M.

Detroit Roentgen Ray and Radium Society
Secretary, Dr. E. F. Lang, Harper Hospital, Detroit, Mich. Meets monthly first Thursday, October to May, at Wayne County Medical Society Building.

East Bay Roentgen Society
Secretary, Dr. Dan Tucker, 434 30th St., Oakland 9, Calif. Meets first Thursday each month at Peralta Hospital, Oakland.

Florida Radiological Society
Secretary, Dr. H. G. Reaves, Medical Arts Bldg., Sarasota, Fla. Meets twice annually, in the spring with the annual State Society meeting, and in the fall.

Georgia Radiological Society
Secretary, Dr. Robert M. Tankesley, 218 Doctors Bldg., Atlanta, Ga. Meets in mid-winter and at annual meeting of Medical Association of Georgia in the spring.

Greater Miami Radiological Society
Secretary, Dr. R. D. Shapiro, 541 Lincoln Rd., Miami Beach, Fla. Meets monthly at various South Florida Hospitals.

Houston Radiological Society
Secretary, Dr. Harry Fishbein, 324 Medical Arts Bldg., Houston 2, Texas. Meets fourth Monday each month at Hermann Hospital.

Idaho State Radiological Society
Secretary, Dr. Alfred M. Stone, St. Lukes Hospital, Boise, Idaho. Meets annually at same time as Idaho State Medical Association.

Illinois Radiological Society
Secretary, Dr. Stephen L. Casper, 1101 Maine St., Quincy, Ill. Meets three times a year.

Indiana Roentgen Society
Secretary, Dr. William M. Loehr, 712 Hume-Mansur Bldg., Indianapolis 4. Meets second Sunday in May.

Iowa Radiological Society
Secretary, Dr. James T. McMillan, 1104 Bankers Trust Bldg., Des Moines, Iowa. Luncheon and business meeting during annual session of Iowa State Medical Society. The scientific section is held in the autumn.

Kansas Radiological Society
Secretary, Dr. Willis L. Beeler, M.D., 700 Kansas Ave., Topeka, Kansas. Meets in spring with State Medical Society, and in winter on call.

Kentucky Radiological Society
Secretary, Dr. David Shapiro, 323 East Chestnut St., Louisville 2, Ky. Meets monthly on second Friday at Seelbach Hotel, Louisville.

Kings County Radiological Society
Secretary, Dr. Solomon Maranov, 1450 51st St., Brooklyn 19, N. Y. Meets Kings County Med. Soc. Bldg. monthly on fourth Thursday, October to May, 8:45 P.M.

Los Angeles Radiological Society
Secretary, Dr. George Jacobson, 1200 N. State St., Los Angeles 33, Calif. Meets second Wednesday each month at Los Angeles County Medical Association Building, Los Angeles.

* Secretaries of societies are requested to send timely information promptly to the Editor.

Maine Radiological Society
Secretary, Dr. Jack Spencer, Maine General Hospital, Portland 4, Maine. Meets in early spring, June and fall.

Maryland Radiological Society
Secretary-Treasurer, Dr. H. Leonard Warres, 2337 Eutaw Place, Baltimore 17, Maryland.

Miami Valley Radiological Society
Secretary, Dr. G. A. Nicoll, 134 Apple St., Dayton, Ohio. Meets second Friday of fall and winter months.

Mid-Hudson Radiological Society
Secretary, Dr. J. W. Walton, Horton Memorial Hospital, Middletown, N. Y. Meets 8:30 P.M., fourth Tuesday each month, September to May.

Milwaukee Roentgen Ray Society
Secretary, Dr. T. J. Pfeffer, 839 N. Marshall St., Milwaukee 2, Wis. Meets monthly on second Monday at University Club.

Minnesota Radiological Society
Secretary, Dr. John R. Hodgson, Mayo Clinic, Rochester, Minn. Meets three times annually, once at time of State Med. Assn., and in spring and fall.

Mississippi Radiological Society
Secretary, Dr. John W. Evans, 117 N. President St., Jackson, Miss. Meets third Thursday of each month at the Rotisserie Restaurant at 6:30 P.M.

Montana Radiological Society
Secretary, Dr. Grant P. Raitt, Suite 413 Medical Arts Bldg., Billings, Montana. Meets at least once a year.

Nassau Radiological Society
Secretary, Dr. Frank Huber, Hempstead, N. Y. Meets second Tuesday of the month in February, April, June, October and December.

Nebraska Radiological Society
Secretary, Dr. J. F. Kelly, Jr., 816 Medical Arts Bldg., Omaha, Nebr. Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln.

New England Roentgen Ray Society
Secretary, Dr. Stanley M. Wyman, Massachusetts General Hospital, Boston, Mass. Meets monthly on third Friday, Harvard Club.

New Hampshire Roentgen Ray Society
Secretary, Dr. A. C. Johnston, Elliott Community Hospital, Keene, N. H. Meets four to six times yearly.

New York Roentgen Society
Secretary, Dr. J. R. Freid, 1049 Park Ave., New York 28, N. Y. Meets monthly on third Monday, New York Academy of Medicine, at 8:30 P.M.

North Carolina Radiological Society
Secretary, Dr. W. C. Sternbergh, Charlotte Memorial Hospital, Charlotte, N. C. Meets in May and October.

North Dakota Radiological Society
Secretary, Dr. C. O. Heilman, 807 Broadway, Fargo. Meetings by announcement.

Northeastern New York Radiological Society
Secretary, Dr. D. H. Baxter, Albany Hospital, Albany, N. Y. Meets in Albany area on second Wednesdays of October, November, March and April.

Northern California Radiological Society
Secretary, Dr. H. B. Stewart, 2920 Capitol Ave., Sacramento, Calif. Meets at dinner last Monday of each month, September to June.

Ohio State Radiological Society
Secretary, Dr. M. M. Thompson, 316 Michigan St., Toledo, Ohio. Annual meeting, Toledo, Ohio, May 22 and 23, 1954.

Oklahoma State Radiological Society
Secretary, Dr. John R. Danstrom, Medical Arts Bldg., Oklahoma City, Okla. Three regular meetings annually.

Oregon Radiological Society
Secretary, Dr. J. W. Loomis, 919 Taylor St. Bldg., Portland 5, Oregon. Meets monthly from October to June on the second Wednesday of each month at 8:00 P.M. at the University Club.

Orleans Parish Radiological Society
Secretary, Dr. Joseph V. Schlosser, Charity Hospital, New Orleans 13, La. Meets first Tuesday of each month.

Pacific Northwest Radiological Society
Secretary, Dr. S. J. Hawley, 1320 Madison St., Seattle 4, Wash. Meets annually in May.

Pacific Roentgen Society
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif. Meets annually, during meeting of California Medical Association.

Pennsylvania Radiological Society
Secretary, Dr. J. M. Converse 416 Pine St., Williamsport. Next annual meeting at Bedford Springs Hotel, Bedford, Penna., May 14 and 15, 1954.

Philadelphia Roentgen Ray Society
Secretary, Dr. H. M. Stauffer, Temple University Hospital, Philadelphia 40, Pa. Meets first Thursday of each month, at 5 P.M., from October to May in Thompson Hall, College of Physicians.

Pittsburgh Roentgen Society
Secretary, Dr. Donald H. Rice, Western Pennsylvania Hospital, Pittsburgh 24, Pa. Meets 6:00 P.M. at Webster Hall Hotel on second Wednesday each month, October to May inclusive.

Radiological Section, Baltimore Medical Society
Secretary, Dr. H. Leonard Warres, 2337 Eutaw Place, Baltimore 17, Md. Meets third Tuesday each month, September to May, inclusive.

Radiological Section, Connecticut Medical Society
Secretary, Dr. William A. Goodrich, 85 Jefferson St., Hartford 6, Conn. Meetings are held bi-monthly.

Radiological Section, Medical Society of the District of Columbia
Secretary, Dr. A. C. Wyman, 5445—28th St., N.W., Washington, D. C. Meets Medical Society Library, third Wednesday of January, March, May and October at 8:00 P.M.

Radiological Section, Southern Medical Association
Secretary, Dr. Roy G. Giles, Temple, Texas.

Radiological Society of Greater Cincinnati
Secretary, Dr. Chapin Hawley, 927 Carew Tower, Cincinnati 2, Ohio. Meets monthly from September to June on first Monday of each month at 7:30 P.M. at the Cincinnati General Hospital.

Radiological Society of Hawaii
Secretary, Dr. P. S. Arthur, Young Hotel Bldg., Honolulu 13, T. H. Meets third Friday of each month at a place designated by the Secretary.

Radiological Society of Kansas City
Secretary, Dr. Arthur B. Smith, 800 Argyle Bldg., Kansas City, Mo. Meets third Thursday of each month.

Radiological Society of Louisiana
Secretary, Dr. J. T. Brierre, 700 Audubon Bldg., New Orleans. Meets annually during Louisiana State Medical Society Meeting.

Radiological Society of New Jersey
Secretary, Dr. Salomon Silvera, 921 Bergen Ave., Jersey City, N. J. Meets at Atlantic City at time of State Medical Society and in November in Newark, N. J.

Radiological Society of Southern California
Secretary, Dr. Donald R. Laing, 65 N. Madison Ave. Pasadena 1, Calif.

Richmond County Radiological Society
Secretary, Dr. W. F. Hamilton, Jr., University Hospital, Augusta, Ga. Meets first Thursday of each month at various hospitals.

Rochester Roentgen Ray Society, Rochester, N. Y.
Secretary, Dr. A. Gordon Ide, 277 Alexander St., Rochester 7, N. Y. Meets at 8:15 P.M. on the last Monday of each month, September through May, at Strong Memorial Hospital.

Rocky Mountain Radiological Society
Secretary, Dr. John H. Freed, 4200 East Ninth St., Denver 7, Colo.

St. Louis Society of Radiologists
Secretary, Dr. W. B. Seaman, 510 South Kingshighway, St. Louis 10, Mo. Meets fourth Wednesday each month, except June, July, August and September.

San Antonio-Military Radiological Society
Secretary, Dr. Hugo F. Elmendorf, Jr., 730 Medical Arts Bldg., San Antonio 5, Texas. Meets Brook Army Medical Center Officers Mess first Monday of each month.

San Diego Radiological Society
Secretary, Dr. C. W. Bruner, 2456 Fourth Ave., San Diego 1, Calif. Meets first Wednesday of each month at the University Club.

San Francisco Radiological Society
Secretary, Dr. I. J. Miller, 2680 Ocean Avenue, San Francisco 27, Calif. Meets quarterly.

Section on Radiology, California Medical Association
Secretary, Dr. H. R. Morris, 1027 "D" St., San Bernardino, Calif.

Section on Radiology, Illinois State Medical Society
Secretary, Dr. George E. Irwin, Jr., 703 N. East St., Bloomington, Ill.

Shreveport Radiological Club
Secretary, Dr. R. W. Cooper, Charity Hospital, Shreveport, La. Meets monthly on third Wednesday, at 7:30 P.M., September to May inclusive.

South Bay Radiological Society
Secretary, Dr. J. J. McCort, Santa Clara County Hospital, San Jose, Calif. Meets second Wednesday each month.

South Carolina Radiological Society
Secretary, Dr. William A. Klauber, Self Memorial Hospital, Greenwood, S. C. One meeting with South Carolina Medical Association in May, others arranged by President.

Tennessee Radiological Society
Secretary, Dr. G. K. Henshall, 311 Medical Arts Bldg., Chattanooga, Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

Texas Radiological Society
Secretary, Dr. R. P. O'Bannon, 650 Fifth Ave., Fort Worth 4, Texas.

University of Michigan Department of Roentgenology Staff Meeting
Meets each Monday evening from September to June, at 7:00 P.M. at University Hospital.

University of Wisconsin Radiological Conference
Secretary, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis. Meets first and third Thursdays 4:00 to 5:00 P.M., September to May, Service Memorial Institute.

Utah State Radiological Society
Secretary, Dr. Angus K. Wilson, 343 S. Main St., Salt Lake City 1, Utah. Meets fourth Wednesday in January, March, May, September and November at Holy Cross Hospital.

Virginia Radiological Society
Secretary, Dr. P. B. Parsons, Norfolk General Hospital, Norfolk, Va. Meets annually in October.

Washington State Radiological Society
Secretary, Dr. Eva L. Gilbertson, 1317 Marion St., Seattle 4, Wash. Meets fourth Monday of each month from September through May at 610 Pine St., Seattle.

West Virginia Radiological Society
Secretary, Dr. W. Paul Elkin, 515 Medical Arts Bldg., Charleston, W. Va. Meets concurrently with annual meeting of West Virginia State Medical Society; other meetings arranged by program committee.

Westchester Radiological Society
Secretary, Dr. C. G. Huntington, 170 Maple Ave., White Plains, N. Y. Meets on third Tuesdays of January and October and on two other dates.

Wisconsin Radiological Society
Secretary, Dr. W. W. Moir, 309 Geele Ave., Sheboygan, Wis. Special meetings held during year; annual meeting each spring at Madison, Wis.

X-Ray Study Club of San Francisco
Secretary, Dr. Wm. W. Saunders, Veterans Administration Hospital, San Francisco 21, Calif. Meets monthly, third Thursday, at 7:45 P.M., Lane Hall, Stanford University Hospital.

Cuba, Mexico, Puerto Rico and Central America

Sociedad de Radiología y Fisioterapia de Cuba
President, Dr. J. Manuel Viamonte, Hospital Mercedes, Habana, Cuba. Meets monthly in Habana.

Sociedad Mexicana de Radiologia y Fisioterapia
General Secretary, Dr. D. P. Cossio, Marsella No. 11, Mexico, D. F. Meets first Monday of each month.

Asociación Puertorriqueña de Radiología
Secretary, Dr. Rafael A. Blanes, Ave. Ponce de Leon 1175, Santurce, P. R.

Sociedad Radiológica Panameña
Secretary, Dr. L. Arrieta Sanchez, Apartado No. 86, Panama, R. de P. Meets monthly in a department of radiology of a local hospital, chosen at preceding meeting.

British Empire

British Institute of Radiology Incorporated with the Röntgen Society
Ordinary meeting, on the Thursday preceding the third Friday, October to May at 8:15 P.M.
Medical Members' meeting, on third Friday in each month at 5:00 P.M., 32 Welbeck St., London, W 1.

Faculty of Radiologists
Honorary Secretary, Dr. J. F. Bromley, 45, Lincoln's Inn Fields, London, W.C.2, England.

Section of Radiology of the Royal Society of Medicine (Confined to Medical Members)
Meets third Friday each month at 4:45 P.M. at the Royal Society of Medicine, 1 Wimpole St., London.

Canadian Association of Radiologists
Honorary Secretary-Treasurer, Dr. D. L. McRae, Suite 305, 1555 Summerhill Avenue, Montreal 25, Que. Meetings January and June.

Section of Radiology, Canadian Medical Association
Secretary, Dr. C. M. Jones, Inglis St., Ext. Halifax, N. S.

Société Canadienne-Française d'Electrologie et de Radiologie Médicales
Secretary, Dr. Origéne Dufresne, 4120 Ontario St., East, Montreal, P. Q.

College of Radiologists (Australia and New Zealand)
Honorary Secretary, Dr. Alan R. Colwell, c/o British Medical Agency, 135 Macquarie St., Sydney, N.S.W.

South America

Asociacion Argentina de Radiologia
Secretary, Dr. Lidio G. Mocsa, Avda. Gral. Paz 151, Córdoba, Argentina. Meetings held monthly.

Sociedad Argentina de Radiologia, Junta Central, Buenos Aires
Secretary, Dr. Oscar F. Noguera, Santa Fe 1171, Buenos Aires. Meetings are held monthly.

Sociedad Argentina de Radiologia, Filial del Litoral, Sede, Rosario
President, Dr. Francisco P. Cifarelli. Meets monthly second Wednesday, 19 ha 663 Italia St., Rosario, Santa Fe.

Sociedad Argentina de Radiologia, Filial del Sur, Sede, La Plata
President, Prof. Dr. Jose P. Uslenghi, La Plata. Meets monthly.

Sociedad Argentina de Radiologia, Filial del Centro Sede, Cordoba
President, Prof. Dr. David L. Caro, Corro 86, Cordoba. Meets monthly.

Sociedad Argentina de Radiologia, Filial del Norte, Sede, Tucuman
President, Dr. Julio Mendez Valladares, Rivadavia 358, Tucuman. Meets monthly.

Sociedad Argentina de Radiologia, Filial de Cuyo Sede, Mendoza.
President, Dr. J. A. Orfila, Hospital Central, Mendoza. Meets monthly.

Sociedade Brasileira de Radiologia Medica
Secretary, Dr. Nicola Caminha, Av. Mem de Sa, Rio de Janeiro, Brazil. Meets monthly, except during January, February and March.

Sociedade Brasileira de Radioterapia
Secretary, Dr. Oscar Rocha von Pfuhl, Av. Brigadeiro Luiz Antonio, 644 São Paulo, Brazil. Meets monthly on second Wednesday at 9:00 P.M. in São Paulo at Av. Brigadeiro Luiz Antonio, 644.

Sociedad Colombiana de Radiologia
Secretary, Dr. Luis E. Lozano B., Carrera 12 No. 20–69, 6º piso, Bogota, Colombia. Meets last Thursday of each month.

Sociedad Peruana de Radiologia
Secretary, Dr. Julio Bedoya Paredes, Apartado 2306, Lima, Peru. Meets monthly except during January, February and March, at Asociación Médica Peruana "Daniel A. Carrión," Villalta, 218, Lima.

Sociedad de Radiologica, Cancerologia y Fisica Medica del Uruguay
Secretary, Dr. Arias Bellini, Av. Agraciada 1464, Piso 13, Montevideo, Uruguay.

Continental Europe

Société Belge de Radiologie
General Secretary, Dr. S. Masy, 111 Avenue des Allies, Louvain, Belgium. Meets monthly, second Sunday at Maison des Médecins, Brussels.

Société Française d'Electro-Radiologie Médicale, and its branches: Société du Sud-Ouest, du Littoral Méditerranéen, du Centre et du Lyonnais, de l'Ouest, de l'Est, et d'Alger et d'Afrique du Nord
Secretary-General, Dr. A. Dariaux, 9 bis, Boulevard Rochechouart, Paris IX°, France.

Ceskoslovensk společnost pro rëntgenologii a Radiologii v Praze
Secretary, Dr. Roman Bláha, Praha XII, stát. nemocnice, Czechoslovakia. Meets monthly except during July, August, and September. Annual general meeting.

Polish Society of Radiology
Secretary, Dr. L. Zgliczynski, 59 Nowogrodzka St., Warsaw, Poland.

Gdansk Section, Polish Society of Radiology
Secretary, Dr. A. Smigielska, Akademia Lekarska, Gdansk. Meets monthly last Sunday at 10:30, X-Ray Dept., Akademia Gdansk.

Wroclaw Section Polish Society of Radiology
Secretary, Dr. R. Marciniak, Akad. Medyczna Wrocław, 68 Curie-Skłodowska St., Wrocław, Poland. Meets first Sunday of each month, X-Ray Department, Akademia Medyczna Wrocław.

Societatea Romana de Radiologie si Electrologie
Secretary, Dr. Oscar Meller, Str. Banual Mărăcine, 30, S. I., Bucuresti, Roumania. Meets second Monday in every month with the exception of July and August.

All-Russian Roentgen Ray Association, Leningrad
USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson. Meets annually.

Scandinavian Roentgen Societies
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association.

Sociedad Espanola de Radiologia y Electrologia
Secretary, Dr. J. Martin-Crespo, Fuencarral, 7. Madrid, Spain. Meets monthly in Madrid.

Schweizerische Röntgen-Gesellschaft (Société Suisse de Radiologie)
Secretary, Dr. Max Hopf, Effingerstrasse 47, Bern, Switzerland.

Deutsche Röntgen-Gesellschaft
Secretary, Dr. med. Peter Kröker, Evangelisches Krankenhaus, Huyssens Stiftung, (22a) Essen. Annual meeting, Sept. 5–8, 1954, Wiesbaden, Germany.

Societa Italiana di Radiologia Medica
Secretary, Prof. Mario Ponzio, Ospedale Mauriziano. Torino, Italy. Meets biannually.

India

Indian Radiological Association
Secretary, Dr. R. F. Sethna, Navsari Building, Hornby Road, Bombay 1, India.

CENTRE ANTOINE BÉCLÈRE FOR INTERNATIONAL RELATIONS IN MEDICAL RADIOLOGY

Founded by Dr. Claude Béclère and by Mlle. Antoinette Béclère, son and daughter of the famed pioneer of radiology, the Centre Antoine Béclère has in its short existence, made long strides towards its educational aims and for the betterment of international aid and understanding in radiology. Located at 7 rue Perronet, half a block from the recently inaugurated new School of Medicine of the University of Paris, the Centre Béclère is sure to become the guiding light of those seeking training in radiology or who wish to visit the hospitals while in France. The present facilities consist of a library, a museum, study rooms and a secretarial office; the visitor will find the Centre animated by the incessant activity and the captivating charm of Mlle. Béclère. Students and visitors may avail themselves, under special circumstances, of lodging and other privileges. To those interested in the early history of international meetings the Centre offers programs, lists of officers, titles of papers, etc., of conventions dating back to the beginning of the century. Information is always available to the visitor in respect to visiting hours, courses, lectures, etc. The Centre Antoine Béclère issues a monthly bulletin in French and English which is mailed to subscribers.

American radiologists contemplating a visit to France may avail themselves of the valuable help offered by the Centre Béclère and should plan to visit it while in Paris; time will be saved and more fruitful visits and contacts will be made.

Dr. Béclère and Mlle. Béclère have honored their illustrious father in a manner which will bring their personal warmth and understanding into international relations.

J. A. DEL REGATO, M.D.

REGISTRY OF RADIOLOGIC PATHOLOGY AT THE ARMED FORCES INSTITUTE OF PATHOLOGY

This is to remind radiologists of the services that are being rendered by the Registry of Radiologic Pathology, Washington, D. C., sponsored by the American Roentgen Ray Society, the Radiological Society of North America, and the American College of Radiology.

As is known, the Registry is the national archives for interesting cases of teaching value to which roentgenologists throughout the country are willing to contribute for its growth.

Your participation in this growth is earnestly solicited by forwarding to the Registry cases of this type. It is only in this way that a continuous supply of material can be accumulated for study, classification, analysis and correlation with pathologic findings. The information gained from this processing is reflected back to the medical profession in the form of loan sets, exhibits, and research facilities.

Collections, prepared exhibits, and reported cases are most welcome. In addition to the roentgenograms, the Registry requests a brief clinical abstract of the case and the histopathology slides which help to establish the diagnosis. If possible, colored photographs of the gross pathology are also very desirable.

The original roentgenograms will be duplicated on 8 by 10 inch transparencies to be filed in the Registry. The contributor's roentgenograms will be returned to him. The slides of the microsection will be kept in order to supplement the future usefulness of the case. (If it is more convenient to sent the tissue blocks, the Armed Forces Institute of Pathology will make their sections, after which the blocks will be returned.)

The material should be addressed to: The Director, Armed Forces Institute of Pathology, Attention: Radiologic Registry, Washington 25 D. C.

If further information is desired concerning the activities or services offered by the Radiologic Registry, address: The Registrar, Radiologic Registry, Armed Forces Institute of Pathology, Washington 25, D. C.

Inter-Society Committee for the

Registry of Radiologic Pathology
John D. Camp, M.D., *Chairman*
Paul C. Swenson, M.D.
Aubrey C. Hampton, M.D., *Secretary*

GREATER MIAMI RADIOLOGICAL SOCIETY

At the January, 1954, meeting of the Greater Miami Radiological Society, the following officers were elected for the calendar year: *President*, Dr. E. Hampton Bryson; *Vice President*, Dr. Raymond E. Parks; *Secretary-Treasurer*, Dr. Richard D. Shapiro, 541 Lincoln Road, Miami Beach, Florida. The Society holds monthly meetings throughout the year at various South Florida hospitals.

KENTUCKY RADIOLOGICAL SOCIETY

The Kentucky Radiological Society, at its January meeting, elected the following officers for 1954: *President*, Dr. Everett L. Pirkey, Louisville; *Vice President*, Dr. Robert D. Shephard, Lexington; *Secretary-Treasurer*, Dr. David Shapiro, Louisville.

RICHMOND COUNTY RADIOLOGICAL SOCIETY

The new year for the Richmond County Radiological Society began with the election of officers, with Col. H. R. Osheroff, *President;* Dr. Jack Levy, *Vice President;* Dr. William F. Hamilton, Jr., *Secretary-Treasurer*. The meetings are held on the first Thursday of each month, with the first meeting at the University Hospital, the second at the Lenwood Annex, the third and fourth at the University Hospital, and the fifth and last of the year at the Lenwood Annex.

ST. LOUIS SOCIETY OF RADIOLOGISTS

At a recent meeting of the St. Louis Society of Radiologists the following officers were elected for the year 1954: *President*, Dr. Donald S. Bottom; *Vice President*, Dr. Francis O. Trotter, Jr.; *Secretary-Treasurer*, Dr. William B. Seaman, 510 South Kingshighway, St. Louis 10, Missouri.

UTAH STATE RADIOLOGICAL SOCIETY

At the annual meeting of the Utah State Radiological Society the following officers were elected for the ensuing year: *President*, Dr. L. P. Matthei; *Vice President*, Dr. Ralph Meyer, Salt Lake City; *Secretary-Treasurer*, Dr. Angus K. Wilson, Salt Lake City. Meetings for 1954 are to be held on the fourth Wednesday in January, March, May, September and November in the Conference Room of the Holy Cross Hospital. Scientific presentations will precede the business meeting.

JOSEPH FREEDMAN LECTURES IN DIAGNOSTIC ROENTGENOLOGY

On Saturday and Sunday, April 24 and 25, 1954, Dr. Richard Schatzki, Instructor in Radiology, Harvard Medical School, and Chief Roentgenologist, Mt. Auburn Hospital, Cambridge, Massachusetts, will deliver the sixth annual Joseph Freedman Lectures in Diagnostic Roentgenology at the University of Cincinnati College of Medicine. Radiologists desiring to attend are requested to write Dr. Benjamin Felson, X-ray Department, Cincinnati General Hospital, Cincinnati 29, Ohio, for further details.

OHIO STATE RADIOLOGICAL SOCIETY

The annual meeting of the Ohio Radiological Society will be held in Toledo, Ohio on May 22 and 23, 1954.

DEUTSCHE RÖNTGEN-GESELLSCHAFT

The Thirty-sixth Annual Meeting of the Deutsche Röntgen-Gesellschaft will be held in Wiesbaden, Germany, September 5–8, under the chairmanship of Dr. med. H. Lossen.

BOOK REVIEWS

Books sent for review are acknowledged under: Books Received. This must be regarded as a sufficient return or the courtesy of the sender. Selections will be made for review in the interest of our readers as space permits.

La tomographie de la base du crâne en neuro-chirurgie et neuro-ophtalmologie. Par H. Fischgold, Électro-radiologiste des Hôpitaux de Paris; M. David, Neuro-chirurgien des Hôpitaux de Paris; et P. Brégeat, Ophtalmologiste des Hôpitaux de Paris. Paper. Price, 1600 fr. Pp. 138, with 107 illustrations. Masson et Cie, 120, boulevard Saint-Germain, Paris 6, France, 1952.

The authors emphasize the importance of collaboration between the radiologist, the neurosurgeon and ophthalmologist in determining the exact nature of minute changes in roentgen anatomy preoperatively, and stress the need of pathological and postoperative checkups on the initial interpretations.

A description of the geometry of tomography is given in the general section and the use of Porot's radio-anatomic plates of normal cross-section anatomy are given in each section. These radio-anatomic plates are invaluable in studying tomographic roentgenograms of the skull because they give one the best possible idea of the normal appearance of sections through the cranium in various planes.

This monograph is divided into eight sections, as follows: (1) general considerations of indications for and uses of tomography; (2) tomography of the orbit; (3) tomography of the olfactory region; (4) tomography of the sphenoorbital intersection; (5) tomography of the sella turcica; (6) tomography of the temporosphenoidal fossa; (7) tomography of the basilar apophysis; and (8) tomography of the occipitocervical articulation.

In the first section on the orbit it is shown how clearly one can demonstrate the exact area of involvement of portions of the medial, inferior, superior and lateral walls of the orbit by planar roentgenologic dissection. The importance of frontal, sagittal and tangential planigraphic planes is emphasized.

The use of tomography in delineation of olfactory groove meningiomas is graphically shown. Attention is drawn to such signs as lateral displacement of the crista Galli, clouding and displacement of adjacent ethmoid cells and inferior convexity of the floor of the olfactory groove as seen in the profile view.

In tomograms of the spheno-orbital intersection, exact comparison can be made of the anterior clinoid processes in the frontal plane. The authors point out that these changes are often not appreciable on standard projections, but may be useful in showing erosions in conditions such as aneurysm of the internal carotid, glioma of the optic chiasm, tumor of the frontal lobe and meningioma of the lesser wing of the sphenoid bone.

Planigraphy of the sella turcica is incomplete when carried out only in the sagittal plane. It must also be studied in the frontal or coronal plane. At least three sections are necessary: one through the tubercle of the sella, one through the mid-pituitary fossa and one through the posterior clinoid processes and dorsum sellae. By this means, much more detailed information about the extent of depression of the floor of the sella into the sphenoid sinus, and to which side it is depressed, can be obtained. Examples of the use of this method in tumors of the pituitary body, meningioma of the tuberculum sellae, and finally alteration of the sella turcica by intracranial hypertension caused indirectly by astrocytoma of the posterior fossa are given.

In study of the temporosphenoidal fossa (middle cranial fossa) tomographies are done in three dimensions: the frontal (nose-forehead), sagittal (profile), and horizontal, *i.e.*, submental-vertical, with the plane of the fossa parallel with the film. By this means, changes in the foramina of the base, and evidence of increased or decreased pressure can be shown by variations in the dimension of the two sides as in cerebral atrophy, plagiocephaly and localized increased pressure as of a cerebral hydroma.

For investigation of the basilar apophysis (the clivus and its extension to include the basisphenoid and basi-occiput) sagittal or profile tomograms are recommended by the authors. They cite one case of a chordoma demonstrated by this means.

Finally, the authors describe the use of tomograms in the diagnosis of occipitocervical

malformations, using both sagittal and frontal planes. By this means they are able to get a very clear image of the odontoid process of the axis and the hard palate as well as the posterior margin of the foramen magnum, useful in the diagnosis of basilar impression or platybasia.

This monograph is highly recommended to all who are dealing with neuro-roentgenology as a lucid presentation of the application of tomography to delineation of important details of neuro-anatomy.

Lewis E. Etter, M.D.

X-Ray Diagnosis of Chest Diseases. By Coleman B. Rabin, M.D., Assistant Clinical Professor of Medicine, College of Physicians and Surgeons, Columbia University; Associate Physician for Chest Diseases and Associate Radiologist, Mt. Sinai Hospital; Consulting Physician for Chest Diseases, Beth El Hospital; Senior Consultant for Chest Diseases, Veterans Administration. Cloth. Price, $12.00. Pp. 208, with 288 illustrations. Williams and Wilkins Company, Mt. Royal and Guilford Avenues, Baltimore 2, Maryland, 1952.

In this stimulating book the author has presented his material in a somewhat unusual but very logical and thorough manner. He believes that the roentgenogram as a means of revealing gross pathological change should be interpreted objectively and without the necessity of a background of clinical information about the patient. The roentgenogram should be treated as a demonstration of the pathological anatomical changes present in a given disease process at one stage in its development. In carrying out this approach to roentgen diagnosis the author has discussed the various problems in the traditional manner of the pathology textbook. One section is devoted to general roentgen pathology and another to regional roentgen pathology. In the former the various roentgenologic manifestations of single pathological processes are discussed. Congestion, atelectasis, emphysema, infiltration, consolidation, and other types of involvement are each discussed at length. These are the elements which, in certain combination, are the principal evidence of disease shown in the roentgenogram, and in each instance the underlying anatomical change is correlated with the roentgen appearance. In the section on regional pathology, the various diseases affecting each of the intrathoracic structures is described in detail, in terms of the anatomical abnormalities enumerated in the previous section.

This approach to the roentgenogram is detached and objective and aims at obtaining as much information as possible from the roentgenographic study. This is in contradistinction to fitting the roentgen changes into a pattern which has already been determined by the tentative clinical diagnosis. The author thus advises a synthetic approach, building a diagnosis step by step from the individual roentgen features presented; and this is opposed to the analytic approach of one who interprets the roentgen changes in the light of a known clinical picture. Stated differently, the roentgenogram should be used to explain the clinical picture rather than using the clinical picture to explain the roentgen findings.

The author's presentation of his method is highly successful. This rational approach to roentgen diagnosis is very important, and particularly so to one beginning training in radiology. Too often young radiologists learn from example to rely on visual memory of a previous case and make a diagnosis because of a similar case seen in the past. The approach advised by Dr. Rabin does not minimize the value of experience, but stresses a reasoning attitude in which the individual features of a roentgen picture are each carefully noted as depicting an underlying anatomical change. It is only in this way that the full value of roentgenology in explaining the pathogenesis of various disease processes can be realized, and thus, that the ultimate benefit to the patient is greatest.

The first part of the book deals with types and techniques of roentgen examination. The technique of roentgenoscopy is particularly detailed, and in this section a surprising statement is made, considering that the remainder of the book appears to be directed toward the roentgenologist. He seems to commend roentgenoscopy of the patient's chest by the physician performing the physical examination, and advises use of roentgenoscopy for re-examination of the chest when there is no special indication for a roentgen examination. This in essence makes each physician his own roentgenologist. The value of such a situation is at least debatable.

An interesting addition to the volume is the fourth major division of the text, a section on the differential diagnosis of certain roentgen shadows. These commonly observed shadows

are discussed with emphasis upon those features which will permit differentiation. Nodular lesions, miliary lesions, sharply defined linear shadows, and others are considered, and the various features are described which would permit differentiation on the basis of roentgen evidence alone. At times, of course, the roentgen evidence is only one link in a chain of factors, no one of which will permit a definite diagnosis.

There is an excellent index, a good bibliography of recent literature, and many illustrations which are adequately reproduced. The volume is reprinted from a general looseleaf textbook of roentgenology, and the original pagination is retained. This is a minor inconvenience. The heart, great vessels and esophagus are not discussed in detail.

The volume is an excellent reference textbook, but, more than that, it continuously keeps in the foreground the pathological background of the visualized roentgen changes, and for this reason, if for no other, should be in the hands of every resident in roentgenology. It will be interesting and stimulating reading for any radiologist and a valuable addition to his library.

E. F. Lang, M.D.

Radiologic Diagnosis of the Lower Urinary Tract. By Donald E. Beard, M.D., Assistant in Urology, Emory University School of Medicine, etc.; William E. Goodyear, M.D., Assistant in Urology, Emory University School of Medicine, etc.; and H. Stephen Weens, M.D., Professor and Chairman, Department of Radiology, Emory University School of Medicine, etc. Cloth. Price $6.50. Pp. 143, with 279 illustrations. Charles C Thomas, Publisher, 301 East Lawrence Avenue, Springfield, Illinois, 1952.

In this small volume the authors have presented a concise summary of the use of contrast media in roentgen diagnosis of lower urinary tract abnormalities. The contribution is all the more valuable in light of the scanty treatment frequently given this topic in larger systems dealing with the entire field of roentgen diagnosis. Despite a compact format, this book covers well its intended scope. Throughout the various sections brief introductory text is followed by numerous reproductions of roentgenograms often accompanied by drawings superimposed upon similar reproductions to illustrate the surrounding soft tissue anatomy.

The text begins with a description of history, anatomy and technique of contrast study together with illustrations of normal procedures. There follow numerous excellent reproductions of the various pathological states affecting urethra and bladder accompanied by captions describing in detail the crucial points to be noted in diagnosis. A final section is devoted to the topic of urethrography and cystography in children. This last discussion should be of special value to the roentgenologist whose daily practice may not bring him in contact with a sufficient number of studies to produce familiarity with this specialized field.

It is felt that this contribution should prove to be a valuable addition to the library of urologist and radiologist not only as a didactic manual but also as a compact reference atlas of roentgenologic diagnosis in lower urinary tract abnormalities.

F. R. Birkhill, M.D.

Annual Review of Medicine. Windsor C. Cutting, Editor, Stanford University School of Medicine, and Henry W. Newman, Associate Editor, Stanford University School of Medicine. Volume 3. Cloth. Price, $6.00. Pp. 442. Annual Reviews, Inc., Stanford, California, 1952.

One of the most pressing problems confronting the modern physician is the difficulty in keeping abreast with the tremendous volume of medical literature which is published annually. There are obviously two important aspects of the situation; first, how is it possible to become aware that certain articles have been published recently, and, second, how can it be determined which are the most informative and reliable.

The Annual Review of Medicine is one of several publications which gives a critical and comprehensive résumé of the current contributions in the medical field. Its editors and editorial board, judging by Volume 3, the 1952 publication, have accomplished this task satisfactorily and deserve the commendation of all physicians who have an interest in the progress of medicine.

This volume of 442 pages, which is thoroughly indexed according to subject matter and authors, is of convenient size. It is divided into twenty-one different chapters which cover the entire field of medicine, and, in addition, includes chapters on psychiatry and diseases of

the nervous system, anesthesia, radiology, diseases of the eye, toxicology, and laboratory aids to diagnosis and therapy. If one desires further information dealing with the recent literature on any given medical subject, additional references are available in the last chapter of the volume which is devoted to annotated lists of reviews in medicine.

In an effort to evaluate this publication more critically, the chapter of eighteen pages with 353 references, dealing with disorders of the blood and the reticuloendothelial system, was scrutinized with care. My impression was that the review has been presented thoroughly and comprehensively and with excellent critical judgment. The reviewer, having participated in a similar publication over a period of years, appreciates how much time and effort are required to accomplish a work of this nature. He hopes this publication will continue on the present high level of efficiency. Such periodic résumés are essential for extending farther the borders of our knowledge, to teaching both undergraduate and postgraduate students, and also to assist the practitioner in the most effective daily care of patients.

Cyrus C. Sturgis, M.D.

Symposium on Radiobiology. The Basic Aspects of Radiation Effects on Living Systems. Oberlin College, June 14–18, 1950. Edited by James J. Nickson. Editorial Committee: P. Morrison, M. Burton, E. S. Guzman Barron, G. Failla, H. M. Patt. Sponsored by The National Research Council of the National Academy of Sciences. Cloth. Price, $7.50. Pp. 465, with numerous illustrations. John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, New York, 1952.

This book is a collection of twenty-three papers in the general field of radiobiology which were presented at a symposium arranged by the Subcommittee on Radiobiology of the Committee on Nuclear Sciences of the National Research Council. Given by as many authors, the series is necessarily somewhat disconnected, if one thinks in terms of a general treatise in the field. On the other hand, many specialties are covered and the average reader will be introduced to new horizons outside of his normal interests. Additional value is rendered through the printing of the detailed discussions following each subject. Some of the discussions were particularly provocative and served to demonstrate gaps in our knowledge or divergent opinion regarding observed phenomena. The experimental, or theoretical radiobiologist will therefore find much food for thought and study in its pages. To the average practicing radiologist, some of the material will be cast at a plane too far removed from his daily interests, yet his time in studying it will be well spent.

The papers can be divided roughly into four groups, though they are not necessarily so arranged in the book. One group deals mainly with the basic physical principles involved in the interaction between radiation and biological media. One of the most fundamental requirements in radiobiology is a knowledge of the mechanism by which energy is transferred from ionizing radiations to the cell. This is discussed for all types of radiation in relation to a number of specific effects. By no means are all effects covered. A second group of papers treats various phases of biochemical phenomena in relation to the causative radiation. Here some light is shed on the relationships between the kind and quantity of radiation that will produce specific biological effects. In a third group, radiosensitivity of the cell itself is discussed in relation to the energy imparted by radiations ranging from the ultraviolet to the very high energy regions. And, finally, there are several papers dealing with the broad problem of radiation genetics including a review of the basic phenomena of gene mutations.

In all, the book represents a valuable collection of modern works by an impressive list of distinguished authors.

Lauriston S. Taylor

Grundlagen der Strahlentherapie. Physik, Biologie und allgemeine Therapie. Von Dr. med. Richard Kurt Kepp, apl. Professor für Geburtshilfe und Frauenheilkunde an der Universität Göttingen. Mit einem Geleitwort von Prof. Dr. Heinrich Martius, Direktor der Universitäts-Frauenklinik Göttingen. Cloth. Price, DM 38.–. Pp. 357, with 134 illustrations. Georg Thieme, Diemershaldenstrasse, 47, Stuttgart, Germany, 1952.

The author has prepared this book especially for the use of physicians taking training in radiology as well as a source of information for the senior medical student who is interested in obtaining accurate knowledge regarding the problems arising and results obtained in radiation therapy.

The subject matter is divided into seven main sections: radiation physics; radiation biology and general radiation therapy; radiation effect on single organs; radiation effect on the offspring; systemic effect of ionizing radiation; radiation protection; and general discussion of radiation therapy in malignant disease.

In Chapter I the physics of roentgen rays, the roentgen-ray apparatus including the cyclotron and supervoltage units as well as the dosimetry are considered. There are also brief sections on radioactivity and corpuscular radiation (cathode rays, protons, deuterons and neutrons).

In Chapter II a detailed discussion of the biologic effect of radiation is presented; this includes the various theories in this field, the time factor, the wavelength dependence of the biologic effect of radiation and the action of radiation on cells and tissues.

In Chapter III the effect of radiation on a number of organs is discussed. Chosen as examples are skin, connective tissue and muscles, bone, vagina, uterus, ovaries, breast, bladder, rectum, kidneys, spleen, hypophysis, thyroid, adrenals and lungs. Some space is devoted to the injurious effect of radiation on the offspring, the blood, the body in general, and the vegetative nervous system.

Protection against radiation exposure is briefly related in Chapter VI with reference to the rules and regulations dealing with that subject as published by the German Roentgen Society.

In the last chapter the radiation therapy of malignant tumors is discussed in a general way, including the dosage problems arising in this field with a description of the various methods of application. Emphasis is given to neoplasms occurring in the female generative organs, which is understandable, since the author's specialty is gynecology and obstetrics.

A brief but informative historical review precedes the text. An extensive bibliography containing largely references to the European literature is appended. To those physicians with a reading knowledge of German this book can be recommended.

E. A. Pohle, M.D.

Vol. 71, No. 3

ABSTRACTS OF RADIOLOGICAL LITERATURE

Department Editor; T. Leucutia, M.D., Harper Hospital, Detroit 1, Michigan

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ROENTGEN DIAGNOSIS

Head

Carpenter, Malcolm B., and Druckemiller, William H. Agenesis of the corpus callosum diagnosed during life; review of the literature and presentation of two cases. *A.M.A. Arch. Neurol. & Psychiat.*, March, 1953, *69*, 305–322.

The corpus callosum, anterior commissure and septum pellucidum are thought to be derived from a thickening of the lamina terminalis or commissural plate. As development takes place, there are a fusion of the two plates in the midline and an extension posteriorly over the fornices and thalami. The septa of the two sides may be fully or partially fused, leaving an interseptal space, designated as the cavum septi pellucidi. Formation of these structures is completed by the fifth month. An agenesis of the corpus callosum is believed to be due to an arrest in development.

The clinical picture appears to have been quite varied in the reports of cases of this condition in the literature. Grand mal epileptic seizures were present in about 60 per cent of the cases. Mental retardation was the first sympton in 42 per cent. Initial symptoms became apparent before two years of age in over half of the cases, and always appeared before the age of twenty years.

Plain roentgenographic studies of the skull are not diagnostic. Cerebral angiograms do not appear to offer significant help. Electroencephalography also is generally of little assistance. Even surgical exploration is likely to be a poor diagnostic aid, as well as possessing no therapeutic value, and it would seem contraindicated unless unequivocal signs of expanding intracranial lesion coexist.

Diagnosis is best made by encephalography in which the findings are fairly distinctive and pathognomonic, although at times a differentiation from a cyst of the cavum septi pellucidi and a lipoma of the corpus callosum may be difficult. The commonest and most characteristic findings are: (a) dorsal extension and dilatation of the third ventricle; (b) wide separation of the lateral ventricles; (c) dilatation of the posterior horns of the lateral ventricles; (d) angular dorsal margins of the lateral ventricles, and (e) concave mesial borders of the lateral ventricles.

As far as can be determined from the literature, the diagnosis of agenesis of the corpus callosum during life has been made only by encephalographic studies.—*Paul R. Dirkse, M.D.*

Peirce, E. Converse, 2nd. Temporary hemiplegia from cerebral injection of diodrast during catheter aortography. *Circulation*, March, 1953, *7*, 385–392.

The first case was one of aortic pathology of uncertain etiology. Aortography was performed by the percutaneous femoral route. Following the third injection of 70 per cent diodrast with films exposed during the Valsalva maneuver the patient had discomfort in the left head, neck and arm. This disappeared quickly. Thirty minutes later he developed aphasia and right paresis. Eight hours later the spinal fluid pressure was increased and a few red blood cells were present in the fluid. Improvement was noted the next morning and in four days the patient was apparently normal. The films showed a considerable amount of opaque substance in the left carotid and subclavian arteries.

The second case was one of apparent aortic aneurysm. Angiocardiography was unsuccessful because of venous block. Aortography was done by the right percutaneous femoral route. Films were exposed during injection of the opaque medium with the patient performing the Valsalva maneuver. About 110 cc. of 70 per cent diodrast was used. The findings were consistent with the diagnosis of aneurysm. About one hour later the patient had a sudden onset of a left hemiplegia which disappeared by the next morning.

A number of articles dealing with reactions to intravenous opaque media are briefly reviewed. The work of Bromen and Olsson seems especially important.

The precautions recommended to prevent such reactions are: avoid maximum concentration of the opaque medium in the aortic arch or its branches if possible; Valsalva maneuver should not be used; external carotid pressure may be helpful; lesser concentrations of the opaque medium should be used whenever possible; the smallest amount of opaque medium consistent with good films should be injected.

No positive therapeutic measures for such reactions are known.—*E. C. Baker, M.D.*

Neck and Chest

Parshall, Dale B., and Stenstrom, K. W. Malignant lesions of the tonsil. *Radiology*, April, 1953, *60*, 564–572.

This paper is based on 101 cases of malignant lesions of the tonsil seen over a twenty-five year period. After statistically analyzing these cases, a review of the literature is presented, showing that the three year and five year survival rates obtained in this group of patients compare favorably with other reported series.

Treatment is primarily by irradiation using 200 kv. roentgen therapy supplemented by radon implantation. In general, high doses are used, but no rigid treatment plan is adhered to because of great variability in individual tolerance. Small lesions which had not metastasized have the best prognosis. It is shown that limited local extension does not

materially affect the survival rate provided there is no lymph node involvement. If there are demonstrable lymph node metastases, these may be eradicated by irradiation although surgery was used in a few cases. In advanced cases, the palliative effect of irradiation seemed to be considerable.—*McClure Wilson, M.D.*

Eskridge, Marshall, and Peake, John Day. Curling of the esophagus. *South. M. J.*, March, 1953, *46*, 213–220.

Curling of the esophagus was observed in 18 of a group of 2,295 patients examined fluoroscopically (0.78 per cent). The anatomy, physiology, and innervation of the esophagus are briefly discussed. Review of the literature revealed that all authors agreed that the condition occurred typically in nervous, high strung individuals over the age of fifty in whom some other organic disease, usually of the gastrointestinal tract, was present. The authors' cases followed the same pattern with the predominant symptom being dysphagia, often with pain beneath the lower sternum.

Fluoroscopically the appearance is that of multiple ring-shaped constrictions appearing as soon as the barium reaches the lower esophagus. Dilatations of the esophagus above each constriction are so marked that they appear as diverticula. Peristaltic waves pass down the esophagus independent of the constricted areas.

Treatment is not satisfactory. Drugs, dilatation and psychotherapy have been tried. Associated disease of the esophagus must be ruled out and differentiation from the following should be considered: carcinoma with obstruction, ulceration, esophagitis, stricture, scleroderma, acrosclerosis, cardiospasm, foreign bodies, and varices.—*Fay H. Squire, M.D.*

Barata, Rogelio. Las estenosis esofagicas. (Esophageal stenoses.) *Arch. Hosp. Universitario, Habana*, March–April, 1953, *5*, 73–108.

Diminution or obliteration of the esophageal lumen may be accompanied by the following symptoms: dysphagia, retrosternal pain, and regurgitation of food. Other symptoms include: regurgitation of saliva, cough, hemorrhage, malnutrition, pulmonary complications, expulsion of tumor fragment and symptoms of the mediastinal syndrome. Other conditions which may simulate the picture of esophageal obstruction include: mediastinal adenopathy, aneurysms, enlarged left atrium of heart, vascular anomalies and mediastinal abscess.

Obstructive lesions of the esophagus may be classed grossly into congenital and acquired types. Congenital lesions include total and segmental obstruction, congenital esophageal diaphragm, tracheo-esophageal fistula and congenitally short esophagus. The larger group of acquired lesions is divided into numerous subgroups. Traumatic lesions include those due to foreign bodies, wounds, caustics, irradiation and cicatrix. Tumoral obstruction may be due to benign intraluminal or intramural tumor, or to the malignant carcinoma and sarcoma. Inflammatory lesions include esophagitis, ulcer, syphilis and tuberculosis. An obstructive lesion of unknown etiology may be seen in scleroderma. Cervical and epiphrenic diverticula form another sub-group. Functional disorders include curling, achalasia and cardiospasm secondary to other diseases. Hiatal hernias form the sixth sub-group of acquired lesions.

Treatment of the various lesions is discussed, including pertinent points in surgical treatment.—*Charles M. Nice, Jr., M.D.*

Krauss, H. Einengung von Trachea und Oesophagus durch Kongenitale Missbildung der Mediastinalgefässe und ihre Behandlung. (Narrowing of trachea and esophagus by congenital anomaly of the mediastinal vessels and its treatment.) *Thoraxchirurgie*, April, 1953, *1*, 25–33.

The embryological development of the large blood vessels is discussed. The most frequent vascular anomalies consist of four types: (1) Double aortic arch. This has never been diagnosed in the living but has been described in anatomical studies at least 30 times. (2) A frequent type is that in which the aorta pursues its normal course to the left, while the right subclavian artery arises from a diverticulum rest of the right primitive aorta as the last vessel from the aortic arch, and crosses on the right side behind the esophagus. (3) Right-sided aorta, which crosses anterior to the trachea and to its right. Usually, the descending aorta is on the right but later crosses into the left side to reach the normal hiatus for the aorta in the diaphragm. In order of origin from the aortic arch are the left subclavian and common carotid arteries, which may have a common trunk, the left innominate, then the right common carotid and subclavian arteries. (4) The most frequent type is the one in which there is a right-sided aorta with the left subclavian arising as the last vessel from the arch, from a posteriorly situated aortic diverticulum. The left subclavian has its origin on the right side and crosses behind the esophagus to the left.

Right-sided aorta is no rarity. Biedermann reported 7 such cases in 5,000 fluoroscopic chest examinations. In 10 per cent of the cases, there may be symptoms referable to swallowing. When there is a double aortic arch, tracheal stenosis is a frequent finding and usually leads to early death. Roentgen diagnosis of a right-sided aorta rests on finding an aortic knob on the right, with no such knob on the left side. Also, the esophagus is displaced to the left and anteriorly. Absence of a posterior impression on the esophagus is not against such a diagnosis.

One case is reported in a thirty-four year old female, in whom an indentation on the posterior wall of the trachea could be seen. A large pulsating aortic diverticulum was noted over the vertebral column, displacing the esophagus and trachea anteriorly and to the left. The patient complained of difficulty in breathing so thoracotomy was done to relieve the pressure on trachea. A right-sided aorta was found, with the left common carotid artery being the first vessel to come off. The left subclavian arose from an aortic diverticulum which lay behind the trachea and esophagus. Between this diverticulum and pulmonary artery was a 2.5 mm. thick strand, corresponding to an obliterated ductus Botalli. This strand appeared to be under tension and was, therefore, separated. The vascular ring which was closed on the left by this strand was thus opened and the esophagus and trachea allowed to herniate. The patient had no more difficulty in breathing after the operation.

Attention is drawn to the good surgical therapeutic response in patients with right-sided aorta, as in the author's case, when symptoms referable to swallowing or breathing are related. Naturally, one must first exclude other conditions such as mediastinal tumors, etc.—*Samuel Richman, M.D.*

Haubrich, R. Über das Ulcus oesophagi bei schwerer Kyphoskoliose. (Esophageal ulcer in severe kyphoscoliosis.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, April, 1953, *78*, 419–428.

The frequency of esophageal peptic ulcer as diagnosed by esophagoscopy is, according to Chevalier and Jackson, 2.2 per cent. The author found in 25 cases of severe kyphoscoliosis of the dorsal spine examined for dysphagia or cardiac complaints an esophageal ulcer in 5 cases.

The ulcers were located in the middle third on the anterior wall. In this region, the esophagus forms an acute angle, which might be the cause of ulceration.

The 5 cases are described in detail and the respective roentgenograms are reproduced.—*Karol E. Matzinger, M.D.*

Luzzatti, Guido, and Perotti, Bruno. La stratigrafia in proiezione laterale nella diagnostica delle affezioni del torace. (Stratigraphy in the lateral projection in the diagnosis of affections of the thorax.) *Radiol. med.* April, 1953, *39*, 321–356; May, 1953, *39*, 417–443; June, 1953, *39*, 529–567.

The subject is divided into three parts:

I. Introduction; Alterations of the pleura; Alterations of the pulmonary parenchyma in general,

II. Alterations of the pulmonary parenchyma with particular localization; Alterations of the bronchi,

III. Alterations of the hili; Alterations of the mediastinum; Conclusions.

The authors discuss in great detail the laminagraphic findings in the lateral projection in all the above enumerated conditions and use numerous reproductions of beautiful laminagrams and diagrams to illustrate the points of interest.

The following general conclusions are reached: Laminagraphic examination in the sagittal plane is a valuable method, complementing conventional roentgen studies and especially frontal laminagraphy, in the diagnosis of various lesions of the chest. Not infrequently it represents the most important means of establishing the true nature of the lesion. In a previous article dealing with the results of their laminagraphic investigations in the lateral projection of the normal chest, the authors stated that the anteroposterior diameter of the lung is greater than the transverse diameter and that the vascular and bronchial ramifications are situated predominantly in a paramediastinal sagittal plane. Therefore, it is not at all surprising that the projection leading to most information should be the lateral rather than the frontal one, particularly since differentiation of the many superimposed shadows is often desirable. Indeed, the authors found that the greatest sphere of usefulness of lateral laminagraphy is in the study of the bronchi and, above all, of the pulmonary vessels. Thus, they were able to demonstrate by this method lesions of the bronchi of the middle lobe and of the apex of the lower lobe and of certain pulmonary vessels which could not be visualized by frontal laminagraphy.

The authors also refer briefly to transverse axial laminagraphy (Vallebona) and consider on theoretical basis the relative indications of this method. They state that the lateral and the transverse axial laminagraphies are two methods which complement each other and that both are of great usefulness in selected instances.—*T. Leucutia, M.D.*

Krall, J., Hoffheinz, H. J., and Wilhelm, E. Der venöse Katheterismus und die mediastinale Venographie beim malignen intrathorakalen Tumor. (Venous catheterization and mediastinal venography in malignant intrathoracic tumor.) *Thoraxchirurgie*, April, 1953, *1*, 84–92.

A malignant intrathoracic new growth is the most frequent cause of mechanical obstruction of the superior vena cava. The symptomatology, known as the superior vena cava syndrome, consists of cyanosis of the face, swelling of the neck, venous collateral circulation over the anterior thorax, and enlargement of the veins of the arms.

The authors studied a number of cases of malignant intrathoracic tumors by means of catheteriza-

tion of the right auricle, frequent pressure measurements, and mediastinal venography. Fifty cubic centimeters of 80 per cent contrast material were injected within two or three seconds with a pressure apparatus. The best roentgenograms were obtained when they were taken while the last 10 cc. were being injected. Serial films are not necessary. Bilateral injection is now preferred, and the entire blood flow of the superior vena cava may be demonstrated.

Several illustrative cases depicting encroachment upon and involvement of the superior vena cava are presented.

The following types of changes on the mediastinal vessels were made out: simple displacement or torsion of the vessels; compression of various degrees; circular constriction with irregular stenosis; and infiltrative or polypoid invasion of the vessels. The last two types are characteristic of malignant tumors.

The criteria for inoperability of the tumor are: total closure of the vessel; polypoid filling defects of the vessel; irregular stenosis as a result of circular narrowing of the vessel; filling defects in the veins, signifying contralateral metastases.—*Samuel Richman, M.D.*

Benoit, Hector W., Jr., and Ackerman, Lauren V. Solitary pleural mesotheliomas. *J. Thoracic Surg.*, April, 1953, *25*, 346–357.

Mesotheliomas in general are discussed and Stout's classification is cited which is as follows:

1. Diffuse spreading type of pleural mesothelioma which is highly malignant.
2. Benign mesothelioma of the male and female genital tracts.
3. Benign and malignant solitary fibrous mesothelioma of the pleura and rarely of the peritoneum.

This report is confined to the discussion of benign solitary pleural mesothelioma and 6 cases are added to the previously 11 reported in the literature.

The solitary benign pleural mesothelioma is a fibrous tumor with a variable amount of stroma and cellularity. It shows intrapleural extension from its pleural origin whereas the malignant type invades subpleurally. The benign solitary mesothelioma occurs about equally in men and women. The youngest patient was twelve years and the oldest was sixty-four years of age with an average age of over fifty years.

There is no typical clinical symptom complex for the tumor; most of the cases were detected on casual roentgenologic studies. Mild chest pain and cough were the most common symptoms. Four patients had slight weight loss and 2 had hemoptysis. Three patients had severe arthralgia and clubbing of the fingers as presenting complaints. The clubbing disappeared after removal of the tumor, as did the hypertrophic osteoarthropathy which was present in 1 case.

The roentgen findings are usually not diagnostic. The differential diagnosis includes bronchiogenic carcinoma, bronchial adenoma, metastatic carcinoma, pericardial cyst, interlobar effusion and mediastinal tumor. Diagnostic pneumothorax has not been particularly helpful in differentiating between intrapulmonary or extrapulmonary location since the tumors, while not infiltrating the lung, are sufficiently adherent to resist separation by a low pressure pneumothorax.—*Paul C. Olfelt, M.D.*

Felton, Warren L., II. The reaction of pulmonary tissue to lipiodol. *J. Thoracic Surg.*, May, 1953, *25*, 530–542.

In this study, 37 resected lung specimens of patients who had received intratracheal lipiodol for bronchography 23 to 295 days prior to operation, were examined histologically by a method which differentially stains lipiodol. In 23 (62 per cent) of these specimens residual lipiodol was demonstrated; roentgenological evidence of retained lipiodol correlated closely with the histological demonstration of the material.

There was no evidence of localization of lipiodol in lymphatics or bronchial walls. The oil is probably eliminated by way of the tracheobronchial passages. In 16 per cent of the lung specimens examined and in 26 per cent of those containing residual lipiodol, focal peripheral foreign body granulomas surrounding lipiodol droplets were observed. The development of such gramulomas may be related to abnormal retention of lipiodol in emphysematous regions. Whether the lipiodol granulomas demonstrated are of any clinical significance is undetermined, but the granulomatous tissue reaction to lipiodol in the lung is more common than is generally suspected. Residual lipiodol not involved in a granulomatous process lies in droplets free or phagocytosed in alveolar or bronchial lumens.—*Paul C. Olfelt, M.D.*

Worth, G. Silikose und Siliko-Tuberkulose; Ergebnisse der Anwendung der internationalen röntgenologischen Klassifikation (Typ "Cardiff-Douai") durch deutsche Gutachter an Hand von 150 Lungenfilmen von Bergleuten aus Süd-Wales.—Abänderungsvorschlag zur internationalen Klassifikation. (Silicosis and silicotuberculosis; results of the use of the international roentgenologic classification ["Cardiff-Douai" type] by German experts on the basis of 150 chest films of miners from South Wales.—Proposal for a change in the international classification.) *Tuberkulosearzt*, April, 1953, *7*, 187–194.

The Cardiff-Douai classification of silicosis was tested by a group of German chest physicians at the suggestion of the British author, C. M. Fletcher, in

order to determine whether this classification corresponded satisfactorily to the German classifying system. This article contains a statistical evaluation of the experience made in comparing the two classifications. On the basis of this study, the German group is proposing a rearrangement of the Cardiff-Douai classification.—*Albert Oppenheimer, M.D.*

Worth, G., and Heinz, W. Über Bronchialveränderungen bei der Silikose und Siliko-Tuberkulose. (Bronchial changes in silicosis and silicotuberculosis.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, March, 1953, *78*, 263–272.

Bronchography is indicated where a discrepancy between the clinical and conventional roentgen findings exists; in bronchitis of unknown etiology, and in differential diagnosis of many conditions. It is not employed in febrile cases, in active tuberculosis with cavitation, or when gangrene is present. When tuberculosis is supected, liberal use of streptomycin prior to bronchography is recommended.

Bronchography is useful in determining the extent of bronchitis associated with silicosis; bronchiectasis; bronchial stenosis produced by extra- or intrabronchial changes; atelectasis due to displacement or distortion of bronchi; emphysema of the obstructive or bullous type; cavitation; localized or generalized bronchial spasm; localization of nodular foci; and pulmonary dynamics based on the rapidity of resorption of the water-soluble contrast material. As a rule, the roentgenographic findings are directly proportional to the severity of the disease.—*Joseph Zausner, M.D.*

Haubrich, R., and Schuler, B. Über die Lungenstruktur im Röntgenbild seltener Pneumokoniosen. (Roentgenographic findings in rare types of pneumoconioses.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, March, 1953, *78*, 272–281.

The differential diagnosis of pneumoconiosis is extremely difficult. Various types of early changes in rare forms of dust inhalation diseases are discussed:

1. Fine strandlike densities typical of corundum lung are also seen in the aluminum lung and resemble chronic bronchitis.

2. The lacy network found in the soot lung is also seen in Boeck's sarcoid and resembles the honeycombing of bronchiectasis.

3. Miliary granules typical of ocher dust and iron ore lung are also seen in Boeck's sarcoid as well as hemosiderosis.—*Joseph Zausner, M.D.*

Huzly, A. Zur Fistelbildung des Bronchialbaumes. (Formation of fistulas of the bronchial tree.) *Tuberkulosearzt*, April, 1953, *7*, 194–205.

The author classifies bronchial fistulas in two main groups: common and rare. Among the common fistulas he lists bronchonodular, bronchopulmonary, bronchopleural and bronchobronchial fistulas; among the rare, broncho-esophageal, bronchocutaneous and broncho-abdominal fistulas.

Bronchonodular fistulas are caused by necrosis of peribronchial or interbronchial lymph nodes, usually as a result of tuberculosis, especially during either early or advanced age, when the bronchial wall is less firm than during the intervening adult years. Sometimes these fistulas are the only source of tubercle bacilli in the sputum. Their incidence has been variously estimated at between 10 and 30 per cent of all cases of tuberculosis but was only 3 to 4 per cent in the series of the author. A diverticulum of the bronchial wall may represent the eventual outcome of such a fistula. Bronchoscopically, the lesion while active is seen as a localized prominence impinging upon the lumen, appearing dark red, with a yellow "point" at its summit; more rarely, a large ragged crater containing caseating material is observed. Gradually the redness subsides and the prominence grows flatter, and finally only a fold or a star-shaped puckering remains visible. Occasionally, a small opening in the bronchial wall persists. When the lesion involves a segmental bronchus the changes above described can rarely be seen, and only a stenosis of the bronchus is recognized. Similarly a bronchogram reveals nothing but obstruction. Laminagrams have to be interpreted with caution because of the possible confusion with ring-shaped pulmonary vessels near the stem bronchi.

Bronchopulmonary fistulas are indistinguishable from bronchonodular fistulas both clinically and bronchoscopically. They are caused by caseation of lung tissue in the vicinity of a bronchus and may be recognized on laminagrams by the fact that a cavity is found at a little distance from the bronchial lumen.

Bronchobronchial or *interbronchial* fistulas consist of a communicating lumen between two neighboring bronchi caused by a pulmonary necrosis regardless of etiology. The cavity with its openings into two separate bronchi fills with iodized oil during bronchography. Sometimes the involved bronchi are in different lobes. This is of importance since it may cause a cavity to drain into a lobe that is not primarily affected by the disease.

Broncho-esophageal fistulas may have their origin in esophageal diverticula or may be caused by mediastinal lymphadenopathy, syphilis of the lungs, and more rarely by tuberculosis. There may be no clinical symptoms when the opening in the bronchus is farther cephalad than the opening in the esophagus.

Bronchocutaneous fistulas consist of a combined bronchopleural and pleurocutaneous fistula which are connected by a walled-off empyema.

Broncho-abdominal fistulas are caused by either transdiaphragmatic extension of a subphrenic abscess or abdominal extension of an empyema, with break-

through into a bronchus. Amoebic abscess, hydatid cyst, purulent biliary disease and traumatic injuries may lead to this complication. Finally, fistulas following lobectomy or pneumonectomy, either as a result of abscess in the stump or due to empyema, may be observed.

This concise and factual survey contains many references to the pertinent literature and several good illustrations.—*Albert Oppenheimer, M.D.*

Ransdell, Herbert, T., Jr., and Ellison, Robert G. Volvulus of a lobe of the lung as a complication of diaphragmatic hernia; case report. *J. Thoracic Surg.*, April, 1953, *25*, 341–345.

In a review of the literature, the authors have been unable to find a single case of torsion or volvulus of a lung either occurring alone or as a complication of other conditions including diaphragmatic hernia. This case is, as far as is known, the first case to be reported.

The patient, a twenty-one year old Negro woman, had lower chest and upper abdominal pain, nausea, vomiting, dyspnea, and a cough for about seven days prior to admission to the University Hospital, Augusta, Georgia. A chest roentgenogram and barium enema study demonstrated the proximal half of the colon and some delated loops of small bowel in the right hemithorax. The clinical course suggested the possibility of strangulated bowel in the chest. On surgical exploration, the middle lobe was found to have a long slender pedicle. The right middle lobe was twisted 180° in a counterclockwise direction and infarcted. The torsion was apparently facilitated by the passage of the bowel into the pleural space via the large posterior and lateral defect in the diaphragm and possibly by peristaltic action of the bowel.—*Paul C. Olfelt, M.D.*

Puckett, Thomas F. Pulmonary histoplasmosis; a study of twenty-two cases with identification of *H. capsulatum* in resected lesions. *Am. Rev. Tuberc.*, April, 1953, *67*, 453–476.

The only roentgen finding that might be interpreted as due to histoplasmosis is disseminated pulmonary calcification. The roentgen appearance may simulate tuberculosis or other pulmonary granulomatous lesions.

The author has made a detailed analysis of 22 cases of pulmonary histoplasmosis and classified them into four groups.

I. Focal encapsulated pneumonitis with no satellite lesions.

II. A large focus of encapsulated pneumonitis with small epithelioid tubercles or tiny foci of necrosis surrounded by dense capsules forming adjacent daughter lesions.

III. A large focus of encapsulated pneumonitis with smaller nodose or conglomerate encapsulated foci extending for a considerable distance along lymphatic channels.

IV. A cavity with adjacent tubercles and encapsulated necrotic foci.

All of the cases were diagnosed by identification of the organism from resected pulmonary tissue.—*Allison E. Imler, M.D.*

Stein, Hans, F. Coexisting pulmonary coccidioidomycosis and tuberculosis. *Am. Rev. Tuberc.*, April, 1953, *67*, 477–489.

The author reports 15 cases of coexisting coccidioidomycosis and tuberculosis with 6 of the cases being discussed in detail. Combined infections certainly occur more often than is indicated by the few reports in the literature.

A coccidioidal infection apparently does not predispose to tuberculous infection and the tuberculosis in a dual infection is not more severe than the usual case.

Coccidioidomycosis is, in most instances, a relatively harmless and self-limited disease. In a coexisting infection, the treatment is directed exclusively at the tuberculosis. Pulmonary resection is indicated in a majority of the cases of combined infection since the coccidioidal cavities respond poorly to collapse therapy.—*Allison E. Imler, M.D.*

Meschan, I., Marvin, H. N., Gordon, Vida H., and Regnier, G. The radiographic appearances of hyaline disease of the lungs in the newborn; case report. *Radiology*, March, 1953, *60*, 383–390.

A case of hyaline disease of the lung in a newborn infant is described and the literature is discussed briefly. The infant, delivered by cesarean section, showed no evidence of abnormality at birth except unusually rapid respiration. Brief cyanotic attacks began fourteen hours after delivery and became more severe in spite of pharyngeal aspiration and administration of oxygen. Death ensued thirty-two hours after birth.

At autopsy there was practically complete alveolar atelectasis of both lungs, with considerable dilatation of the atria and alveolar duct segments. Only a small portion of the anterior margin of the middle lobe of the right lung and the medial margin and lower pole of the upper lobe of the left lung were aerated. Hyaline membrane was demonstrated in the aerated spaces of the lungs.

Roentgenogram of the chest, made fourteen hours after delivery, showed partial atelectasis of the right lung with marked shift of the mediastinum to that side. The roentgenogram made four hours later showed the mediastinum in the midline, with further expansion of the right lung.

It is suggested that the roentgenographic demonstration of good aeration of the lung sparadoxically

coupled with progressively increasing respiratory embarrassment in a newborn infant may indicate hyaline disease of the lungs.—*Arno W. Sommer, M.D.*

Willmann, K.-H. Über das Lungentuberkulom. (Tuberculoma of the lung.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, March, 1953, *78*, 281–287.

A tuberculoma may arise from: (1) a tuberculous, primary focus which has failed to heal completely and has formed a connective tissue capsule around itself; (2) a post caseous-pneumonic process; (3) shrinkage of a small tuberculous cavity after closure of the draining bronchus and then calcification of the caseous material within the cavity.

The differential diagnosis may be impossible, so that the author favors resection in any doubtful case—*Joseph Zausner, M.D.*

Wang, C. C. Roentgen features of pulmonary tuberculoma. *Radiology*, April, 1953, *60*, 536–544.

A pulmonary tuberculoma may be defined as a localized tuberculous focus of infection in the lung, firm, encapsulated, laminated, and often with central caseation. Roentgenologically a primary infection may resemble a tuberculoma. Histologically, a tuberculoma has a fibrous encircling capsule. On the roentgenogram, a tuberculoma appears as a rounded, ovoid, or lobulated area of increased density with a sharply defined margin. Occasionally there is a central area of cavitation producing a doughnut-like appearance, when there is seen the outstanding feature of an unusually thick wall. They may be multiple. Their location is usually peripheral and generally in the upper portion of the lobe. Some have increased twice in size within a year. Calcification having a "flecky" appearance may occur.

The differential diagnosis is discussed, but it is admitted that sometimes it is impossible to make a differentiation from the roentgenogram alone.

Surgery is the treatment of choice.

Seven figures of descriptive roentgenograms are included.—*Everett E. Seedorf, M.D.*

Cohen, Samuel L. The right pericardial fat pad. *Radiology*, March, 1953, *60*, 391–393.

The author discusses the occurrence of right pericardial fat pad in obese individuals, and suggests that the knowledge that this structure is occasionally present may aid in explaining a prominence of the upper part of the cardiovascular shadow.

Two cases are reported.—*A. Ralph Watson, M.D.*

Moros G., Gustavo; Neri, Rafael José, and Villagordoa, Guillermo. Fluorodensography with radiopaque substance; a new method for hemodynamic investigation. *Am. Heart J.*, April, 1953, *45*, 495–499.

Electrokymography is a method of studying movement and density changes in structures that are visible fluoroscopically. Important portions of the electrokymographic tracing are the descending and ascending limbs of the ventricular curve. These are due to density changes. The authors propose that injection of a radiopaque substance would cause such changes in density on arrival of the radiopaque substance in the ventricular cavity that they could be better registered on the electrokymogram than on the usual tracing obtained without the presence of injected contrast medium in the ventricular cavity.

To study the hypothesis, in the course of routine urographic study, the heart was visualized fluoroscopically and the photoelectric pickup cell placed in the usual electrokymographic position along the ventricular contour. During the injection of 35 per cent diodrast [amount and speed of injection are not mentioned] an electrokymogram was registered. The arrival of the diodrast in the left ventricle sensibly altered the curve, the depth of which increased as the concentration of diodrast in the ventricle increased. Later 4 cc. of 70 per cent diodrast was employed as injection material for the "fluorodensographic" examination itself.

The investigators believe that the described method may be useful in the following hemodynamic problems:

I. Measurement of circulation times
   - A. Elbow to left ventricle
   - B. Elbow to right ventricle
   - C. Right ventricle to left ventricle (pulmonary circulation time)
   - D. Other circulation times

II. Study of circulatory shunts
   - A. Diagnosis of some congenital malformations of the heart and great vessels
   - B. Arteriovenous fistulas.

Standard electrokymographic equipment may be used satisfactorily, but a double photoelectric cell setup will simplify the procedure and avoid the need of two separate injections to determine the pulmonary circulation time, for instance.—*Harold Fulton, M.D.*

Lewis, Cecil, and Rogers, Lambert. The cervical aortic knuckle which resembles an aneurysm. *Lancet*, April 25, 1953, *1*, 825–826.

The authors report a case of high aortic arch which clinically resembled an aneurysm of the subclavian, carotid, or innominate arteries. They call attention to the fact that at operation the lesion, if ligated, could result fatally and make reference to such occurrences as recorded by other authors. One roentgenogram is reproduced showing a smooth defect of

the esophagus by barium contrast at the level of the fourth and fifth thoracic vertebrae. The article also includes several diagrams depicting the origin of the high aortic knuckle and a general discussion of the problem.

The particular case reported is that of a boy who was first seen at the age of five and last observed at the age of twenty-one. There was an oval tumor, measuring 1½ inches, in the region of the right common carotid artery which exhibited expansile pulsation with a bruit and palpable thrill. The femoral arteries were palpable and appeared equal on the first visit. The right radial pulse was normal but on the left pulsations were barely perceptible in the axilla and none were felt in the brachial, radial or ulnar regions. An operation performed at the age of seven showed that the ovoid tumor consisted of a greatly dilated artery which passed into the right cervical region to the level of the hyoid bone where it formed an acute angle posteriorly and then passed downward into the thoracic cage. No further dissection was made and the wound was closed. One year later, a second operation was performed and the area of the tumor was reinforced with donor fascia. The patient was seen again at the age of eighteen because he had fainted and had been having repeated headaches. The blood pressure at this time was higher in the right arm than in the left. The right palpebral fissure was narrower than the left. There was no difference in the skin temperature. Attempted arteriography was inconclusive and there was no cardiac enlargement. It was also observed that compression of this ovoid mass obliterated the femoral pulses.

The authors conclude that since the patient has been under observation for sixteen years and there has been no increase in the size of the cervical mass this is a case of cervical aortic arch. They suggest that should any respiratory or circulatory difficulty arise in the future the thoracic inlet could be enlarged by removal of the first rib.—*P. B. Parsons, M.D.*

Goyette, Edwin M., and Palmer, Paul W. Cardiovascular lesions in arachnodactyly. *Circulation*, March, 1953, *7*, 373–379.

A case of arachnodactyly (Marfan's syndrome) with autopsy finding of aortic dissecting aneurysm is detailed. The cardiovascular lesions in 34 such cases with postmortem findings are summarized.

This syndrome may show ocular changes, cardiovascular lesions and/or various anomalies. The distal portions of the extremities exhibit abnormal length in relation to the proximal portions. The cardiovascular lesions may simulate rheumatic fever. Dissecting aneurysms in young individuals comprise a third of the collected cases. Roentgen examination of the chest has not been diagnostic. The histologic examination is described as "usually identical."—*E. C. Baker, M.D.*

Curry, Joseph L., Lehman, J. Stauffer, and Schmidt, Edward C. H. Left atrial calcification; report of eight cases verified at surgery for the relief of mitral stenosis. *Radiology*, April, 1953, *60*, 559–563.

In a series of 300 patients who were subjected to mitral commissurotomy for the relief of mitral stenosis, the preoperative roentgenograms and fluoroscopic records were reviewed. Eight cases of left atrial calcification were found among them. In 5 of the 8 cases, calcification was observed by roentgenologic examination or palpated at surgery in the area of the auricular appendage, and in 3 of these 5, it was limited to this area. In the remaining 3, calcification was shown as linear marginal calcification in the body of the left atrium, without involvement of the appendage.

The roentgen finding of a curved linear calcium density within the margin of the left atrium in rheumatic heart disease seems consistent with intramural calcification. If the calcification is laminated or relatively thick, a calcified thrombus must be considered.—*Lynne J. Taylor, M.D.*

Drewes, J. Die retrograde Darstellung der thorakalen Aorta. (The retrograde demonstration of the thoracic aorta.) *Chirurg*, May, 1953, *24*, 201–204.

Thoracic aortography is used mainly for the demonstration of isthmus stenosis of the aorta or in cases of ductus arteriosus when the results of catheterization are not conclusive. The retrograde injection of the contrast material via a peripheral artery is the method preferred by the author.

Under local anesthesia the brachial artery is surgically exposed and a chatheter or a cannula is introduced. Both carotid arteries are manually compressed to avoid the entrance of the contrast material into the cerebral arteries as much as possible. Eighty per cent perabrodil is injected in varying quantities. A series of exposures is made on roll film, simultaneously in anteroposterior and lateral projections. Two or three exposures per second appear to be necessary for a reliable demonstration of the anomalies.

In 18 cases of this type of aortography there was 1 death. In another case there were mild cerebral symptoms. The remaining patients had no complications. According to the literature, retrograde thoracic aortography has almost completely supplanted the direct approach.—*Hans W. Hefke, M.D.*

Marder, Sumner N., Seaman, William B., and Wilson, Hugh M. The pulmonary circulation in the diagnosis of congenital heart disease. *J. Thoracic Surg.*, March, 1953, *25*, 305–315.

TABLE I

A CLASSIFICATION OF CONGENITAL HEART DISEASE

The Pulmonary Arteries are of Increased Caliber	The Pulmonary Arteries are of Decreased Caliber
ACYANOTIC	ACYANOTIC
Patent ductus arteriosus	Isolated pulmonic stenosis (with intact septa)
Atrial septal defect	CYANOTIC
Lutembacher complex	Tetralogy of Fallot
Ventricular septal defect	(Pseudotruncus arteriosus)
Eisenmenger complex	Pulmonic stenosis with atrial septal defect
CYANOTIC	Congenital tricuspid atresia (types 1-b, 2-a)*
Complete transposition of vessels	Persistent truncus arteriosis (type 4)*
Eisenmenger complex	
Congenital tricuspid atresia (type 2-b)*	
Persistent truncus arteriosis (types 1, 2, 3)*	
Congenital mitral atresia	

* Classifications referred to are those of Edwards.

TABLE II

SCHEMA FOR DIAGNOSIS OF CONGENITAL HEART DISEASE

Pulmonary Arteries	Ventricular Hypertrophy	Chronic Cyanosis	Diagnosis	Operable
Large	Left	Rare, Late	Patent ductus arterious	Yes
Large	Right	Rare, Late	Septal defects: Atrial (Lutembacher); Ventricular (Eisenmenger)	No
Large	Right	Early	Various: Eisenmenger's Complex; Transposition of vessels; Truncus arteriosus	No
Small	Right	No	Isolated pulmonic stenosis	Yes
Small	Right	Early	Tetralogy of Fallot	Yes
Small	Left	Early	Pulmonic stenosis with atrial septal defect; Tricuspid atresia	Yes

The authors after correlating the findings of the conventional roentgen study, angiocardiography, catheterization, operative intervention and autopsy examination in their cases of congenital heart disease have found that the single most important contribution is the demonstration of the appearance of the pulmonary circulation. A simple classification (Table I) and a workable diagnostic schema (Table II) on the basis of this criterion and data concerning cyanosis and electrocardiographic findings in ventricular hypertrophy have been devised which will often lead to diagnosis and immediate decision as to advisability of corrective surgery.—*Paul C. Olfelt, M.D.*

ROBBINS, LAURENCE L., and WYMAN, STANLEY, M. Coarctation of the thoracic aorta; signs demonstrable by conventional roentgenography. *New England J. Med.*, April 30, 1953, *248*, 747–752.

Coarctation of the aorta is in most cases surgically correctable. Early diagnosis is imperative so that treatment can be carried out before advanced vascular changes occur. Arteriosclerosis, dilatation and aneurysm of the poststenotic segment or aneurysm of the collateral vessels may make surgical correction too difficult to attempt. Surgical correction is performed in late adolescence or early adulthood.

This study deals with 31 patients of whom 14 had opaque contrast studies. There were 22 males and 9 females, with ages ranging from four to sixty-two years. Conventional roentgenograms were checked against angiograms in 13 cases in an attempt to provide diagnostic signs. Notching of the ribs is not always present and mostly is not apparent before the age of twelve years. The erosion of the ribs results from the enlarged, strongly pulsating intercostal arteries. The internal mammary arteries may produce scalloped indentations in the anterior margins of the lungs suggesting multiple soft tissue masses. Time is required to produce both of these changes. In the present group, rib notching was absent or questionable in 8 cases. Other indirect signs of coarctation are (1) absence of the expected prominence of the aortic "knob," (2) absence of the usual aortic arch impression on the barium-filled esophagus, (3) exaggerated convexity of the proximal descending aorta in a young patient, representing the associated dilatation of the aorta below the coarctation (opposite the bulge the barium-filled esophagus is displaced to the right and caudally by the "poststenotic bulge" of the aorta), (4) hypertrophy and enlargement of the left ventricle with prominent ascending aorta which shows increased amplitude of pulsations, (5) widening of the left superior mediastinum caused by the dilated left subclavian artery.

Angiography will demonstrate the exact site, diameter of the lumen and length of the narrowed segment.

Fluoroscopy, spot films and somewhat overexposed films will afford much diagnostic information. The esophagus must be carefully studied, in a search for displacement and poststenotic dilatation. The minimum number of films should include a routine posteroanterior, an overexposed posteroanterior with Bucky, a left anterior oblique and a left lateral roentgenogram.

While contrast studies are essential to demonstrate the exact anatomy of the coarctation, the coexisting congenital anomalies and the collateral circulation, the above mentioned signs will permit the diagnosis from a conventional roentgenographic study.—*Robert K. Arbuckle, M.D.*

Gross, Robert E. Coarctation of the aorta. *Circulation*, May, 1953, *7*, 757–768.

In this excellent article the author reviews the anatomical, clinical, and laboratory aspects of coarctation of the aorta. He then discusses his surgical technique and the results in 270 cases.

Although constrictions of the aorta can occur anywhere from the midpoint of the arch down to the bifurcation, 98 per cent are located in the first part of the descending aorta just beyond the arch.

The author stresses that the prescence of coarctation is a great hazard for its possessor. A study of the prognosis of this condition reveals that the average age of death is thirty years. For a large group of cases one-fourth will live a normal life span, and the other three-fourths will die of a rupture of the aorta, or superimposed bacterial endarteritis or in the hypertensive state which includes cardiac failure and intracranial hemorrhage.

In the clinical evaluation of coractation of the aorta, the diagnosis can usually be made on physical examination alone. The pulsations and pressures in the legs are reduced below the upper part of the body. The femoral pulse lags behind the radial pulse. In patients beyond the second decade hypertension is almost always present. There is an abnormal rise in this hypertension with excercise. Collateral arterial circulation will demonstrate itself by pulsations along the inferior margins of the ribs and above and below the clavicle. Murmurs are very atypical and not characteristic.

The electrocardiographic findings are important in determining the coexistence of cardiovascular anomaly and the degree of damage present in the myocardium. The ballisto-cardiographic tracing with shortening of the JK stroke is very suggestive of coarctation of the aorta.

The roentgenologic examination in well developed cases shows enlargement of the left ventricle; widening of the ascending aorta; prominence of the left upper portion of the superior mediastinum secondary to enlargement of the subclavian artery which occasionally produces an indentation in the distal part of the aortic arch in the oblique view. Scalloping of the rib margins is a classical sign of aortic constriction and is caused by development of collateral circulation; it is best seen in the mid-ribs and is rarely observed before the age of eight to ten years. Notching may be present on the right side only if the left subclavian artery rises beyond the constriction. With barium in the esophagus there is evident a compression of the esophagus from the dilated portion of the aorta just distal to the obstruction. This coupled with the dilated right intercostal arteries may give the "E" sign. In the lateral view the serrations on the posterior aspect of the esophagus are due to the dilated large right intercostal arteries. Angiocardiography will many times provide additional useful information. The method described by the author is the intravenous injection of 70 per cent diodrast. However, the contrast material may become greatly diluted so that the great arteries are not well visualized. In these cases retrograde technique by injection of either the left radial artery or the left common carotid artery gives good delineations. The angiograms will not determine whether the vessels are rigid or fixed and may not demonstrate the complete length of constriction.

The author believes that all cases of coarctation should be operated upon unless contraindications are present. These contraindications are: (1) severe rheumatic mitral disease, (2) aortic valve regurgitation of grade 3 extent or more, (3) conduction bundle

defect, and (4) advanced myocardial damage. The optimum time for surgery lies between ten to twenty years of age. After this the heart has less reserve, the chest is larger, the exposure is more difficult, the aorta is less elastic, and aneurysms are apt to be found more frequently in the distal segment. In babies surgery is technically feasible but the possibility of a lag in the growth of the anastomatic site predicates that these cases are best tided over by medical means until the optimum age is reached.

In the surgical technique the author advocates adequate blood transfusion, wide exposure, and beginning the dissection distal of the difficult areas, *i.e.*, the upper intercostals and the coarctation site. He stresses that it is essential to remove all the constriction. The anastomosis is accomplished by bringing the ends of the aorta together so that the cut edges are out and the intima is against intima. In 37 cases of this series grafts were necessary. These cases were the ones in which a very long constriction was present, a rigid or inelastic aorta prevented bridging a short gap, or an aneurysm had developed below the coarctation. The author does not believe that symphathectomy is of any real value in treating hypertension secondary to coarctation. He does not use the subclavian artery bypass. In his opinion anticoagulants are not necessary postoperatively. Local anesthesia of the wound with nupercaine in oil has been found to be a valuable aid. Intercostal drainage is provided for three or four days after operation.

In the author's series of cases there has been a progressive improvement of mortality. In the first 100 cases 15 deaths occurred while in the second 100 cases only 2 deaths were noted. This is attributed to: (1) avoidance of operation on patients with cardiovascular complications, (2) abandonment of cyclopropane anesthesia, and (3) wider experience with more ability to handle emergency situations.

In the follow-up evaluation of these cases the critical factor was the relief of hypertension. The return to normal pressure was usually gradual. In 88 per cent there was complete relief of hypertension, 10 per cent had fair results and 2 per cent had no relief at all. No known postoperative aneurysms had developed. There was one disruption occurring one year after operation. In 2 cases postoperative paralysis developed presumably secondary to spinal cord ischemia as no specific cause could be determined at the time of operation. The 37 aortic graft cases have been free of rupture or formation of aneurysm. The short term observation of these aortic graft cases has been gratifying with 29 excellent results, 2 good, 2 fair, and 1 failure as regards role of the hypertension.

The author believes that surgical therapy of coarctation of the aorta now rests on a sound basis and has a great deal to offer patients afflicted with the abnormality.—*T. D. Allison, M.D.*

Tapella, Pedro A. Del diagnóstico radiológico diferencial entre las enfermedades de Hodgson y de Corrigan. (Differential roentgen diagnosis between Hodgson's disease and Corrigan's disease.) *Prensa méd. argent.*, April 17, 1953, *40*, 925–932.

Luetic aortic insufficiency (Hodgson's disease) and rheumatic aortic insufficiency (Corrigan's disease) present distinct hemodynamic effects which should allow roentgenographic differentiation.

Luetic aortic insufficiency has usually been preceded by aortitis which results in widening of the aorta. Since the evolution of the disease is rapid after insufficiency of the aortic valve develops, there is relatively little time for the development of enlargement of the left ventricle. On the contrary, in rheumatic aortic insufficiency there is no aortitis and the relatively long course allows the development of considerable enlargement of the left ventricle.

Eight cases of luetic aortic insufficiency and 15 cases of rheumatic aortic insufficiency are analyzed to illustrate these findings.—*Charles M. Nice, M.D.*

Abdomen

Moore, Horace G., Jr., Fletcher, T. Lloyd, Taylor, Murray E., and Harkins, Henry N. A hazard in the use of the intestinal tube balloon; case report. *Ann. Surg.*, April, 1953, *137*, 565–568.

A case of complete intestinal obstruction caused by gas forming in the mercury-containing rubber balloon of a Cantor tube is reported. It was felt that the gas permeated the rubber and filled the balloon because the intraluminal pressure of the intestine was increased. An analysis of the gases was made and it was found that they corresponded closely to the gases usually found in the lumen of a mechanically obstructed bowel.

Cantor's safeguards for avoiding this complication are discussed. It is recommended that balloons made of neoprene-G be used and that a small opening be left where the balloon is tied to the tube.—*F. B. Markunas, M.D.*

Pirkey, Everett L., Pilla, Lawrence A., and Pipkin, Doris E. Non-malignant roentgen changes in the gastro-intestinal tract associated with aging. *South. M. J.*, May, 1953, *46*, 446–449.

With increasing medical emphasis on the aging process we have begun to realize that in the older segment of our population numerous nonmalignant changes are seen in the gastrointestinal tract which can be diagnosed by roentgenologic means.

This article discusses various lesions frequently seen in the aged in the esophagus, stomach, small intestine and colon. The pathogenesis of these various lesions is also discussed.

The importance of early recognition of benign

changes in the gastrointestinal tract of the aged is emphasized.—*William A. Klauber, Jr., M.D.,*

Kübler, E., and Dortenmann, S. Über ein röntgenologisches Phänomen als Ursache von Fehldiagnosen bei der Lokalisation spitzer, metallischer Fremdkörper im Magen-Darm-Trakt. (A roentgenological phenomenon as the cause of diagnostic errors in the localization of pointed metallic foreign bodies in the gastrointestinal tract.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, April, 1953, *78*, 429–436.

The large majority of swallowed foreign bodies leave the intestinal tract per rectum without causing symptoms. Needles and other pointed metallic foreign bodies as, for instance, knitting needles and nails sometimes penetrate through the wall of the intestine, the descending duodenum being a frequent site.

The authors examined several such cases in which the roentgen appearance suggested perforation of the wall. In 1 case the roentgenogram of the stomach filled with barium showed the point of a knitting needle protruding for several centimeters beyond the gastric lumen. The findings were similar in patients who swallowed a pin, a needle and large nails.

In 4 cases, on exploration, the tip of the needle was visible under the bulging serosa and no perforation occurred.

The authors introduced needles into stomachs of rabbits filled with barium and obtained identical roentgen images. The tip of a graded needle protruded from the barium shadow for 1.5 and 1.8 cm. outwards. On examination of the specimens, a perforation of the mucosa was found and outpouching of the serosa over the tip of the needle imbedded in the subserosal tissues.

The roentgenograms of the 4 patients in whom a perforation was diagnosed roentgenologically but could not be confirmed at laparotomy are reproduced. Five roentgenograms of stomachs of rabbits showing the same phenomenon are also included.—*Karol E. Matzinger, M.D.*

Kleitsch, W. P., and Lawton, R. L. Transpyloric prolapse of gastric mucosa. *Am. J. Digest. Dis.*, March, 1953, *20*, 67–71.

Prolapse of the gastric mucosa through the pyloric canal is the result of hypertrophic gastritis of the antral mucosa. The hypertrophied gastric rugae are forced into the pylorus by gastric peristalsis producing varying degrees of obstruction. The clinical picture is that of chronic gastritis upon which are superimposed the symptoms of an inconstant pyloric obstruction. Many of these patients have symptoms suggesting peptic ulcer and are so treated.

The roentgenologic appearance of prolapsed gastric mucosa varies with the amount of prolapsed mucosa and the degree of obstruction. Three types of roentgenographic pictures have been described. When a moderate amount of mucosa has prolapsed through a relatively normal pylorus a filling defect is produced in the base of the duodenal cap. The result is the "toadstool" or "umbrella" sign which is considered pathognomonic when present. It is possible to have such a high degree of obstruction, due to complete filling of the pyloric canal with prolapsed mucosa, that the duodenal cap will not visualize. The pyloric antrum then has a pinched off appearance producing the so-called "funnel" sign. The third roentgenographic picture is formed when compensatory dilatation of the pyloric canal occurs as a result of stretching of the sphincter muscle. This leads to prolapse of relatively large amounts of antral mucosa into the duodenum. The roentgenogram in this instance shows a dilated pylorus with evidence of gastric rugal pattern extending into the base of the duodenal bulb.

The difficulty of establishing the correct diagnosis is a burden not only for the internist and radiologist; it is possible for the surgeon to overlook the condition at laparotomy. Palpation of the pylorus is inconclusive and although hypertrophied mucosal folds are palpable as a vaguely outlined thickening in the antrum, it is difficult to decide whether or not it really represents pathology.

When dilated pyloric muscle is present, it offers an excellent indicator for gastrotomy. A dilated pylorus in the absence of duodenal obstruction is almost certainly due to prolapse of a gastric polyp or of antral mucosa. Slight thickening palpable in an otherwise normal appearing antrum and in the absence of other pathology is sufficient evidence to do a gastrotomy for confirmation of the diagnosis.

The treatment of the condition should be as simple as possible. A gastric resection is not indicated and should be avoided. When doubt exists, the best procedure is to do a 2 cm. gastrotomy in the anterior surface of the pyloric antrum immediately orad to the pylorus. The hypertrophic rugal fold will be easily demonstrable. With the diagnosis established, the gastrotomy incision can then be lengthened caudad to transect the pyloric muscle, and the defect can be closed transversely (Heineke-Mikulicz pyloroplasty).

The authors review the case histories of 3 patients who were operated on for this condition. A gastrointestinal examination was reported normal in the first case. Gastrotomy revealed hypertrophic gastric mucosa and a Heineke-Mikulicz pyloroplasty completely relieved the gastrointestinal symptoms. The radiologist was able to demonstrate the "umbrella" sign on the films in retrospect. The second patient had two gastrointestinal examinations. The final conclusions on these examinations was that the patient probably had definite ulceration on the gastric side of the pylorus which was strongly suggestive of malignancy. A duodenal ulcer was found at operation so a gastric resection, Pólya type, was done.

Examination of the gross specimen of stomach revealed a ring of gastric mucosa which was prolapsed through the pylorus. The third patient likewise had two gastrointestinal examinations. The first revealed hypertrophic gastritis and the second, gastritis with a probable ulcer on the lesser curvature of the stomach. Exploration revealed a dilated pyloric ring and gastrotomy showed hypertrophic gastric rugae prolapsing through the pyloric canal. A Heineke-Mikulicz pyloroplasty was carried out. All 3 patients were relieved of their gastrointestinal symptoms.

The authors conclude that at least in some cases symptoms are produced by prolapsing gastric mucosa. They feel that the simplest and least mutilating operation is indicated.—*William C. MacCarty, Jr., M.D.*

Lilja, Bengt. Gastric block; a disturbance of gastric motive function. *Acta radiol.*, May, 1953, *39*, 353–367.

In many cases of ulcer of the stomach at or just above the incisura angularis, there is dilatation of the sinus (proximal portion of antrum, or Alvarez' "pars pylorica") of the stomach and definite impairment in the gastric motive function. Although the dilated sinus is usually atonic, occasional deep peristaltic waves pass through the dilated portion. This dilatation and impaired motive power is especially evident in stomachs with large ulcers. Histologic study shows destruction of the muscularis and replacement with fibrous tissue in the walls of these stomachs under and around the ulcers. The stomachs do not recover normal tone and motive function after the ulcer heals.

The term "gastric block" is suggested for the impairment in gastric motive function.—*Lois Cowan Collins, M.D.*

Bird, Robert M. Detection of carcinoma of the stomach in patients with pernicious anemia. *South. M. J.*, May, 1953, *46*, 434–439.

In this article the high incidence of gastric carcinoma in patients with pernicious anemia is discussed. The importance and difficulty of obtaining an early diagnosis is considered and the significance of digestive symptoms developing in the pernicious anemia patient is analyzed. Annual gastrointestinal study is considered to be advisable.

The author feels that roentgen examination of the gastrointestinal tract is the most accurate method of diagnosing early carcinoma of the stomach.—*William A. Klauber, Jr., M.D.*

Bonte, Frederick J., and Friedell, Hymer L. The detection of early carcinoma of the stomach; an evaluation of the roentgen examination of the patient with gastrointestinal symptoms. *Radiology*, April, 1953, *60*, 527–531.

To examine the premises upon which one might base an attack on the problem of early detection of carcinoma of the stomach by roentgen study, the authors reviewed the findings in 3,680 consecutive gastrointestinal examinations. These examinations were conducted upon patients who were referred because of definite gastrointestinal symptoms. Sixty-five per cent of the examinations were negative. In 43 cases neoplastic lesions of the stomach were diagnosed. Thirty-five of these were clear-cut carcinomas as demonstrated roentgenographically and 31 of the 35 were proved by operation and postmortem examination.

The methods and findings of four other surveys for the detection of carcinoma of the stomach are reviewed.

A survey of all persons over the age of forty, regardless of symptoms and clinical findings, would seem to be the method most likely to discover the asymptomatic early carcinomas as well as the symptomatic ones. Such a survey would be a tremendous undertaking.

The authors conclude that the entire matter of survey for the detection of early cancer of the stomach by the roentgenographic technique available is a difficult, if not discouraging, one and that the solution of this problem may lie in other directions.—*Arno W. Sommer, M.D.*

Loose, K. E. Die intra- und postoperative Cholangiographie unter Anwendung von Röntgen-Serienaufnahmen. (Operative and postoperative cholangiography with the use of serial roentgenograms.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, April, 1953, *78*, 437–449.

It is stated that 10 to 20 per cent of all patients operated on for gallstones have residual calculi in the hepatic duct (Pribram, Byrne and others). Hicken found residual stones in 95 per cent of the reoperated cases. He demonstrated residual calculi cholangiographically in 12 per cent of 100 cases examined postoperatively which were missed on palpation or on instrumental exploration. Based on these facts, the author recommends the use of cholangiography during the course of the operation as well as postoperatively in a routine manner.

An important advantage of operative cholangiography is the roentgenographic demonstration during the operation of all the ducts and their possible harboring of calculi that might not be palpated. The operative course can therefore be more definitely outlined. Since using this procedure the author was able to close primarily much more often without bile duct drainage and thereby shortened considerably

the clinical recovery. He also was able to decide much earlier on shunt-anastomosis (choledochoduodenostomy was performed in 12 out of 58 cases).

In patients operated on with spinal anesthesia there is no difficulty in obtaining a good cholangiogram. In cases in which a general anesthesia is preferred the author recommends intubation anesthesia with curare since this allows the suspension of the respiration for one second.

In some instances it is advisable to repeat the procedure after the removal of an impacted stone (Millbourn, Norman, Moreno, Partington and others). Norman recommends exposures in several different positions of the patient while Moreno believes that serial roentgenograms at five minute intervals are indispensable.—*S. Silvera, M.D.*

Hoffmann, Victor. Zur Diagnostik des Gallensteinleidens. (Contribution to the diagnosis of cholelithiasis.) *München. med. Wchnschr.*, April 3, 1953, *95*, 385–388.

The author, a surgeon, believes that in the evaluation of biliary disease the demonstration of gallstones is not the most important factor. The results of cholecystography must be considered in conjunction with the clinical manifestations. Roentgen study of other abdominal organs—urinary tract, stomach, duodenum, colon—should not be omitted.

On the basis of the clinical and roentgen findings the author and his associates were able to reach a correct preoperative diagnosis in 400 out of 405 cases. In 112 of these the clinical findings were so typical that roentgen study was found to be unnecessary. In 6 cases very small gallstones escaped roentgen demonstration.

The author is opposed to transperitoneal cholecystograms and cholangiograms, mainly because in the presence of long-standing biliary disease the position of the gallbladder may be atypical or the gallbladder may be buried under adherent parts of the colon and omentum. The danger of causing peritonitis may therefore be real. He believes that the diagnosis of gallbladder disease can be made by methods that involve less danger.—*Albert Oppenheimer, M.D.*

Dedeu, Ricardo Almasqué, and Braier, Leonardo Oscar. La enfermedad del cístico. (Disease of the cystic duct.) *Prensa méd. argent.*, April 17, 1953, *40*, 932–948.

Noncalculus disease of the cystic duct may result from partial obstruction caused by congenital anomalies and vascular bands or adhesions, combined with inflammatory changes occurring with cholecystitis. The clinical picture is not entirely characteristic but usually there are episodes of biliary colic. During duodenal drainage the flow of A bile is prolonged and painful, the pain being relieved when the B bile flows. Administration of amyl nitrite may reveal whether cystic duct obstruction is due to spasmodic or organic occlusion.

Cholecystography reveals a hypotonic or hypertonic gallbladder with little change after the fatty meal except distention of the neck of the gallbladder.

Operative cholangiography shows constriction of the lumen of the cystic duct and manometry reveals an increase from the normal pressure of 19–21 cm. of water up to 50–60 cm. of water.

Medical treatment with antispasmodics may be successful for varying periods of time. This failing, surgical intervention, usually cholecystectomy, results in cure.—*Charles M. Nice, M.D.*

McGee, Andrew R., Black, Leslie W., and Beattie, Homer. Annular pancreas. *Radiology*, April, 1953, *60*, 532–535.

The embryology and anomalies of the pancreas are described. Occasionally an annular process of pancreatic tissue extends from the head of the pancreas and encircles the duodenum as a thick band. Usually no symptoms are produced, but sometimes it may result in intestinal obstruction, ulceration and hematemesis.

Roentgenologic studies afford the only sure means of identification. The unchanging appearance of the narrowed lumen of the second portion of the duodenum over months of observation is characterisitic.

The surgical treatment is described. A case is reported which is illustrated with three figures.—*Everett E. Seedorf, M.D.*

Montgomery, W. Foster. Meconium ileus; report of a case with successful management. *J.A.M.A.*, May 16, 1953, *152*, 225–226.

The literature on meconium ileus associated with fibrocystic disease of the pancreas is reviewed. The pathology, etiology and diagnosis are discussed.

Preoperative use of enemas should not be used since there is often gangrene present in the small bowel. A flat roentgenogram of the abdomen will usually reveal evidence of obstruction or the sign, described by Neuhauser, of air bubbles in the inspissated meconium.

Four cases are reported to have survived with this condition. The author reports an additional patient in detail who has survived. The child was operated on twice with removal of most of the small bowel. The meconium remaining was washed out with saline. Feeding of a diet low in fat, casein hydrolysates and fat soluble vitamins along with pancreatin kept the child alive for its first year. Chest roentgenograms have been normal and there has been no infection.—*V. L. Peterson, M.D.*

Girdany, Bertram R., Bass, Lee Weil, and Grier, George W. Reduction of ileocecal

intussusception by hydrostatic pressure. *Radiology*, April, 1953, *60*, 518–526.

The authors report the successful reduction of intussusception in 22 infants out of 27 in whom their described hydrostatic method was used. When the method was unsuccessful roentgenographically, it was usually still possible to accomplish a reduction by surgical exploration.

The method is described and illustrated in detail. Essentially, it requires the insertion of an infant's Bardex catheter into the rectum of the immobilized infant. Under fluoroscopic observation, a thin barium-water mixture is introduced into the colon from an enema can 3 feet above the table top. Gentle manipulation may be helpful. After the head of the intussusception has been encountered, a filling defect appears. The barium mixture advances toward the ileocecal valve. Reduction is considered complete when the barium flows freely into the terminal ileum.

If barium has not entered the ileum in ten minutes, the child is allowed to empty the colon. Defecation itself may cause a backflow into the terminal ileum. If the ileum does not fill, hydrostatic pressure may be applied again.

When the ileum cannot be filled, the clinical condition of the patient is evaluated. If the patient is asymptomatic and a mass is no longer palpable, usually a waiting period of eight to twelve hours is recommended before a decision concerning surgery is reached.

Thirteen helpful figures are included.—*Everett E. Seedorf, M.D.*

Stein, Joseph, Colmore, Henry P., and Green, Robert A. Diaphragmatico-pericardial tear with intrapericardial herniation of the transverse colon. *Radiology*, March, 1953, *60*, 417–420.

A case is reported in which an unsuspected traumatic diphragmatic hernia was present and caused symptoms of cardiac disease. The diagnosis was finally made by noting gaseous bowel shadows superimposed on the cardiac shadow. Colon studies showed the transverse colon to be herniated into the chest and surgical exploration revealed this portion of the colon to be within the pericardial sac. Repair of the hernia was followed by complete absence of the previous symptoms.—*Clyde A. Stevenson, M.D.*

Stevenson, Clyde A., and Sommer, Arno W. Differential diagnosis of chronic perforating carcinoma of the colon. *Radiology*, April, 1953, *60*, 485–489.

The authors have reviewed a total of 560 cases of carcinoma of the colon of which there were 61 instances of proved perforation. There was probable perforation in 28 other cases which were not included in the series, because adequate resected material was not available for study. Chronic perforation was proved to have occurred in 10 per cent of the cases, while an additional 6 per cent revealed probable perforation. All carcinomas were located above the rectosigmoid, and acute cases of perforation were not included.

In this survey, pathologic changes which produced alterations on the roentgenogram were emphasized. The roentgenologic changes of chronic perforation were manifest in one of the following ways: (a) evidence of an extrinsic mass; (b) fistula extending from the carcinoma into an adjacent organ; (c) ulceration which permitted barium to extend beyond the normal limits of the intestinal wall.

Seventy-eight per cent of the 61 specimens showed an extrinsic mass which not only extended directly out, but also extended proximally or distally to compress the normal colon. Rarely did it extend in both directions. In each instance, evidence of an annular carcinoma was present, in that there was a sudden change from normal colon to a narrow irregular channel with destruction of the mucosa in the channel area. At either the proximal or the distal end of the channel, however, the colon was compressed by the extrinsic mass, so that return to normal colon was gradual rather than abrupt as in uncomplicated carcinoma.

Excellent photographs of the artist's drawing superimposed on the roentgenogram illustrate the mechanical factors involved in the production of the roentgenographic findings.

Over-all accuracy of diagnosis of chronic perforation was 78 per cent. In the instance of polypoid carcinoma with alteration of the intestinal wall only at the base of the lesion, the authors were unable to find any consistently reliable roentgen signs indicating chronic perforation. In some instances the extrinsic mass did exert pressure on the normal colon, but the presence of a large intraluminal polypoid tumor so distorted the colon that no consistent changes could be demonstrated. This was especially true of carcinoma of the cecum.

The authors emphasize the fact that signs of perforation are associated only with late lesions and poor prognosis.—*A. Ralph Watson, M.D.*

Douglas, James B. The double-contrast examination of the colon. *Radiology*, April, 1953, *60*, 490–495.

The author reviews the subject of double contrast examination of the colon. He uses colloidal barium and aids distribution of air by manipulation of the patient. Stereoscopic anteroposterior and posteroanterior roentgenograms are taken and re-examinations are frequently done. The difficulty in finding colonic polyps at operation is emphasized. Because of the frequency of malignant degeneration of these polyps, a maximum of diagnostic accuracy must be maintained.—*William A. Goodrich, Jr., M.D.*

Yates, Charles W. Double contrast studies of the colon: polyps in children. *South. M. J.*, April, 1953, *46*, 315–319.

Polyps in children should be sought more frequently by double contrast studies. Isolated adenomatous colonic polyps in childhood are relatively less often malignant and more frequently self-amputated than similar lesions in adults. Melena occurs in practically 100 per cent of cases. The frequency of protrusion, diarrhea and abdominal cramps depends on the location of the polyps and their size. The patient, the referring physician and the roentgenologist suffer if the latter accepts responsibility for diagnosis of lesions within reach of the proctoscope.

Preparation for examination must include avoidance of curd-forming liquids and solids in the sixteen hours before the examination. Castor oil is used as a cathartic in a dose of 2 ounces for patients of two years or more and 1 ounce for those under twenty-four months of age. Enemas of soap suds are administered at intervals of fifteen minutes until three enemas have been given. It is well to cancel breakfast because of possible difficulty in demonstration of the right colon later in the morning of the examination.

The presence of melena should be investigated by contrast studies. Polyps which are too small to show on routine colon films or at fluoroscopy can be demonstrated in the anteroposterior, posteroanterior and both oblique views of the colon with double contrast enema, high kilovoltage technique and short exposures.—*John W. Turner, M.D.*

Moreton, Robert D. Double-contrast examination of the colon with special emphasis on studies of the sigmoid. *Radiology*, April, 1953, *60*, 510–517.

Roentgenographic examination of the rectum and sigmoid colon is frequently difficult because multiple, superimposed intestinal loops prevent adequate visualization. Owing to the high incidence of both polyps and true carcinoma in the rectum and sigmoid it is important that this segment of the intestinal tract be examined very thoroughly. The radiologist should not be held responsible for the discovery of lesions within reach of the sigmoidoscope but he should examine this area as adequately as possible.

The author has tried to obtain better visualization of this portion of the intestine by various methods. Double-contrast studies in oblique and lateral views or with stereoscopic films cleared most of the "dark areas." He found that roentgenograms made in the Chassard-Lapiné position were valuable as a supplement to the oblique, lateral and other projections now used in searching of obscure lesions of the colon. This position, advocated by Raap in 1951, is referred to as the "sitting view" by the author. To obtain this view he seats his patient on the table, has him bend as far forward as possible and directs the central ray through the spine and sacrum. This is the last roentgenogram taken to complete the double-contrast study and is obtained after the patient has evacuated any excess of barium that may be collected in the rectum.

Seven cases are presented showing the advantage of this view as a supplement to the other views.—*Arno W. Sommer, M.D.*

Potter, Robert M. Dilute contrast media in diagnosis of lesions of the colon. *Radiology*, April, 1953, *60*, 500–509.

The author re-emphasizes the fact that polypoid lesions of the colon are often potentially malignant and frequently multiple. Repeated examinations may be necessary for reasonable assurance that all parts of the colon have been adequately observed.

Examination of the colon by barium enema using dilute suspensions (4.5 ounces of barium sulfate to a quart of water with suitable suspending agents) combined with high kilovoltage technique, in the author's opinion not only reveals small lesions of the colon, but also retains all the other diagnostic features of the usual barium enema study.

The author's experience indicates that any routine barium enema examination which employs film studies of the filled colon can be made more critical by the above described technique.—*A. Ralph Watson, M.D.*

Gianturco, C., and Miller, George A. Routine search for colonic polyps by high-voltage radiography. *Radiology*, April, 1953, *60*, 496–499.

An analysis of the results of routine examination of the colon is presented with emphasis on the use of a semi-opaque barium suspension. Fluoroscopy of the entire colon is carried out at normal kilovoltage ranges but the procedure is interrupted to obtain high kilovoltage (120 kv.) roentgenograms of the sigmoid area and again of the entire colon after fluoroscopy is completed. The high kilovoltage roentgenograms show the barium suspension to be relatively translucent and negative defects will show up if present. If such a shadow persists without change on two successive examinations a diagnosis of polyp is made.

Of 1,552 patients examined 42, or 2.7 per cent, showed polyps. Only one polyp was found in the rectal area but when 35 of the 42 patients were examined with a proctoscope 9 proved to have rectal polyps. The authors are now doing proctoscopic examinations on all patients as a preliminary to the colon examination.

Of interest is the fact that 28 of the 42 patients who harbored polyps did not complain of bleeding. It is recommended that a routine search be made for

polyps on all adult patients.—*Clyde A. Stevenson, M.D.*

Gynecology and Obstetrics

Jacobs, J. Bay. The value of the lateral pelvic roentgenogram as an index of fetal maturity and type of maternal pelvis. *Am. J. Obst. & Gynec.*, April, 1953, *65*, 897–908.

The author believes that an accurate evaluation of maternal pelvis and fetal head size can be obtained from an upright lateral pelvimetric roentgenogram. He states that if this view is taken on all primiparas with a diagonal conjugate diameter of 11.5 cm. or less, and of every multipara with a diagonal conjugate of 11 cm. or less, no case of borderline or contracted pelvis will escape recognition.

In a large series of cases studied by this method, the biparietal diameter of the fetal skull was visualized in two-thirds of all cases of vertex presentation. From these measurements a graph was plotted which can be used to predict fetal maturity and birth weight with considerable reliability.

The author points out that all these measuremnts and findings must be correlated with accurate clinical impressions.—*George L. Sackett, Jr., M.D.*

Savignac, Eugene M. Roentgen amniography: a valuable and safe aid to obstetrical diagnosis. *Radiology*, April, 1953, *60*, 545–558.

Amniography, performed in the third trimester of pregnancy, can provide valuable information which in some cases would not be obtainable prenatally by any other means. The author feels that the procedure, correctly performed, is harmless to mother and fetus, and that it does not seem to induce labor.

Diodrast, injected into the amniotic cavity by transcutaneous puncture of maternal abdominal and uterine walls, shows placental implantation and fetal or maternal soft tissue deformities, and is swallowed by the live fetus, affording definite evidence of life.

Chief indications are suspected placenta previa or fetal abnormalities not otherwise diagnosed, suspected fetal death, suspected uterine tumors, and unexplained malpresentations. The author's technique is described, and 9 cases are presented.—*Lynne J. Taylor, M.D.*

Genitourinary System

Bohne, A. Waite, and Christeson, Wm. W. Clinical evaluation of a concentrated iodine preparation; for intravenous nephrography and pyelography. *Radiology*, March, 1953, *60*, 401–405.

Evaluation was made of 70 per cent urokon sodium (sodium acetrizoate) used as an agent for intravenous urography and pyelography. Thirteen nephrograms and 100 pyelograms were made, and the latter were compared with an equal number using 30 per cent urokon sodium. The 70 per cent concentration was found to be superior, and in many instances eliminated the need for retrograde pyelograms.

Intravenous nephrography is useful in the study of renal and extrinsic masses and in estimating a functioning tubular mass, as well as in visualizing the collecting system.

Allergic reactions to this concentration may be kept to a minimum by the prophylactic administration of antihistaminic preparations.—*Lynne J. Taylor, M.D.*

Peirce, E. Converse, 2nd, and Ramey, William P. Renal arteriography: report of a percutaneous method using the femoral artery approach and a disposable catheter. *J. Urol.*, April, 1953, *69*, 578–585.

Several methods of renal arteriography are briefly mentioned and their advantages and disadvantages are discussed.

The authors report 25 patients in whom successful renal arteriography was carried out with the use of a percutaneous method of catheterization.

The procedure is as follows: A 12 to 14 gauge needle is inserted into the femoral artery under local anesthesia. A polyethylene catheter is then passed through this needle and threaded to the level of the aorta required for the particular injection to be made. This level is tested by the use of an opaque medium as indicated. To begin with, the catheter is filled with a mixture of heparin and saline and this material is used for the irrigation of the system. After the catheter has been pushed through the needle for a distance varying from 6 to 12 inches, the needle can be removed. The entire length of the catheter is 24 inches and the authors find that if 10 inches remains outside of the incision, the level of the catheter is approximately correct. Twenty cubic centimeters of 20 per cent diodrast is injected using the hand method and a regular 20 cc. syringe. The injection is made while the patient is performing the Valsalva maneuver, and a roentgenogram is taken just before the end of the injection.

The advantages of the percutaneous method are that the equipment is simple and inexpensive, the thin-walled polyethylene catheter allows for an adequate volume flow, relatively smaller amounts of the radiopaque medium are required, and that repeated roentgenograms may be made while the catheter is still in place.

The disadvantages are that the catheter will occasionally not pass to the desired level and that a sizable hematoma may develop at the site of the

introduction of the needle through the femoral artery. Arterial spasm of several hours' duration simulating thrombosis was noted in several instances but no actual thrombosis occurred in this series of patients. Hypersensitivity reaction to the diodrast and the formation of an arteriovenous fistula are occasional complications of this procedure.—*George W. Chamberlin, M.D.*

Youngblood, Vernon H. Vaginal urinary stone. *J. Urol.*, March, 1953, *69*, 433–435.

This is a case report of a six year old girl who had a history of enuresis. The patient had been operated on at the age of three days for some type of a spinal condition. Physical examination revealed a mild hydrocephalus. There was atrophy of the muscles of the pelvis and there was rather marked excoriation and ulceration of the labia and vagina. A large stone was seen protruding from what appeared to be the vaginal orifice but subsequently it was felt that this was protruding from a paralyzed urinary bladder and was presenting at the meatus of the urethra. At operation the bladder was opened but the calculus was not present within the bladder. The vagina was then exposed and a large stone was broken up with a clamp and extracted. The bladder was filled and no urine could be seen to leak into the vagina from the bladder. At a subsequent time cystoscopy was done. The urethra was very small and there was a marked stricture of the meatus. The cystoscopic examination showed a small contracted bladder which was otherwise normal. There was no evidence of a fistulous communication between the bladder and urethra. The child has made a satisfactory recovery.

The causes of vaginal calculi include stagnation of menstrual flow, vaginal cysts, calcifications of the mucous cells and urinary leakage into the vagina. None of these causes could adequately explain the formation of a calculus in this patient.—*George W. Chamberlin, M.D.*

Burkland, Carl E. Fracture of giant ureteral calculus. *J. Urol.*, March, 1953, *69*, 366–371.

This is a detailed case report of an unusual calculus, completely filling the right ureter, which was found in a fifty-three year old woman. The patient had had a known calculus for many years and had refused previous operative procedure until July, 1951, at which time she developed severe pain in the right abdomen and the roentgen examination demonstrated a fracture of the right ureteral calculus. The pathological diagnosis was that of a cigar shaped stone of the ureter, chronic ureteritis and ureterectasis with focal squamous cell metaplasia, hydronephrosis and severe chronic atrophic pyelonephritis.

A review of the literature indicates that giant ureteral calculi are associated with a long standing history of urinary stone. The author arbitrarily chose anything longer than 5 cm. as being indicative of a "giant" stone. The largest one reported by Mayer weighed 286 grams. Many of the patients with giant ureteral calculus complained of vague abdominal pain or gastrointestinal symptoms over a long period of time before the proper diagnosis is made and treatment carried out.

In the case reported in this article, the blood calcium, phosphorus and alkaline phosphatase studies were entirely normal. The calculus was composed of apatite and magnesium ammonium phosphate hexahydrate.

Included are two illustrations, the gross pathological specimen and the roentgenogram, and one chart showing the findings in the 28 cases previously reported in the literature.—*George W. Chamberlin, M.D.*

Prather, George C., and Singiser, James A. The urological importance of radiopaque appendiceal concretions. *J. Urol.*, May, 1953, *69*, 714–720.

The differential diagnosis of appendiceal concretion and right ureteral calculus may, in some instances, be confusing. Appendiceal concretion may produce clinical signs of right renal colic, frequency and hematuria. It therefore becomes the duty of the urologist and the radiologist to differentiate these two conditions.

Appendicoliths may vary in size from 1 mm. to as much as 3 to 4 cm. in diameter, their average size being approximately 0.5 cm. They are generally oval or round in shape, single in number, and show a laminated appearance on the roentgenogram. Chemical analysis indicates 25 per cent inorganic material, chiefly calcium phosphate, 20 per cent organic residue and 55 per cent soaps, cholesterol and coprosterol.

The incidence of appendiceal concretion varies with the authors and an exact figure cannot be given. The importance of the disease is indicated by the fact that the incidence of complications is increased in patients with appendicitis in whom the appendix contains a concretion.

Roentgenograms of good quality with stereoscopic as well as oblique projections may be sufficient for diagnosis. When in doubt, however, a retrograde pyelogram is indicated.

The authors present 3 brief case reports in male individuals in whom the correct diagnosis was made prior to operation and the appendix successfully removed in each case.—*George W. Chamberlin, M.D.*

Valenta, James C., and Chenoweth, Carlin V. Foreign bodies in ureter: a complication from use of electrodes for ureteral meatotomy. *J. Urol.*, April, 1953, *69*, 492–495.

This article deals with 2 cases in which the filiform

tip of a ureteral meatotomy electrode, which had previously been used in cystoscopic meatotomies, had accidentally been broken and left in the ureter. In one instance. The broken end of the electrode was in the right mid ureter and in the other instance, it was in the left upper ureter. These foreign bodies did not pass spontaneously and it was necessary to do a ureterotomy to remove them.

An experimental attempt to produce breakage of such an instrument by passing a large amount of current through it, failed to demonstrate any structural breakdown as a result of such current.

The authors point out that ureteral foreign bodies are rare. The article includes reproductions of the roentgenograms and a photograph of one of the broken electrodes.—*George W. Chamberlin, M.D.*

Osmond, John D., Jr. Foreign bodies in the kidney; review of the literature and reports of four additional cases. *Radiology*, March, 1953, *60*, 375–382.

A foreign body may reach the kidney by one of three routes: through the urethra, bladder and ureter; from the gastrointestinal tract by means of external violence; and, most frequently, by direct penetration.

Reports of only 34 cases of foreign body in the kidney were found in the literature. The author presents 4 additional, previously unreported, cases. In 1 case the foreign body was a bullet. Foreign material which had been introduced at operation was found in 2 cases. The fourth case demonstrated the fact that a swallowed object can penetrate the bowel and lodge in the kidney. A portion of a toothpick was found in the center of a renal calculus. In this case the foreign body had apparently perforated the colon to enter the right renal pelvis.

Results of a study of the previously reported cases are summarized.—*Arno W. Sommer, M.D.*

Katz, Albert B. Gastro-intestinal manifestations of urinary tract disease. *J. Urol.*, May, 1953, *69*, 726–733.

Gastrointestinal manifestations are extremely common in patients with urinary tract disease and may be the only finding in as many as 5 to 38 per cent of such patients. It is not at all uncommon for these patients to undergo major surgical operative procedures without relief of their symptoms because of the mistaken diagnosis of some abdominal lesion, such as appendicitis.

The gastrointestinal factors involved in the particular mechanism are classified as toxic, reflex or mechanical. In some instances a combination of these factors may be the cause. The toxic factors may be predominantly a manifestation of an infectious or uremic process in the urinary tract. The neurological or reflex factors resulting from stimuli originating in the upper urinary tract are found to produce functional disturbances in the gastrointestinal tract and the response to these various stimuli may vary in the same or in different individuals. The anatomic or mechanical factors in the causation of gastrointestinal symptoms are due to the close anatomical relationship between certain portions of the urinary tract and the gastrointestinal tract.

One might divide the gastrointestinal symptoms into gastroduodenal, biliary, appendiceal, colonic and peritoneal. The gastroduodenal clinical picture is that of nausea, vomiting, epigastric pain, pyrosis and belching associated with ureteral or renal colic. Duodenal compression may be associated with nephroptosis. The biliary type of symptomatology is more likely to result from mechanical and pressure effects and is associated with upper urinary tract disease. Appendiceal type of symptomatology may be produced by ureteral or renal stone, stricture, hydronephrosis or pyelonephritis. Colonic symptoms, such as constipation or diarrhea associated with pain or pressure sensation in the lower abdomen, may frequently be associated with lesions of the ureter due to the close proximity of the two organs. The peritoneal group of symptoms are those which simulate intestinal obstruction. Gas retention in urinary tract disease has been frequently noted, and these cases are easily mistaken for ileus or an irritating lesion, such as appendicitis.

The author includes 5 brief case reports illustrating the various symptom complexes associated with urinary tract disease.—*George W. Chamberlin, M.D.*

Naumann, Hans N., and Sabatini, Silvio A. Cholesteatoma of kidney simulating squamous cell carcinoma. *J. Urol.*, April, 1953, *69*, 467–473.

The authors report the case of a fifty-four year old white man who showed clinical and roentgen evidence of a mass of the right kidney. The pathological report on the kidney removed at nephrectomy indicated a benign tumor which apparently met the criteria of a cholesteatoma. There were multiple cortical abscesses and there was one area 1 cm. in diameter which contained brown fluid. Grossly, the appearance was that of a gray-white fibrous mass riddled by areas of caseation measuring 1 to 10 mm. in diameter. The microscopic examination showed numerous cysts varying from small round or ovoid structures to large spaces, all lined by stratified squamous epithelium and filled with cornified cells and amorphous keratin material in a laminated arrangement. Some of the smaller cell masses were solid, resembling pearl nests, while others showed beginning central degeneration with the formation of thin-walled cysts. In addition to the cholesteatoma, there was microscopic evidence of squamous metaplasia, involving the renal pelvis, calyces, upper ureter and extending into the tubular system of the kidney.

The authors were able to find 9 other cases in the literature which met the specifications for cholesteatoma of the kidney. A study of these revealed that cholesteatomas of the kidney are somewhat more common in the male and that the age incidence is between thirty-five and forty-five years. The favorite location is in the renal pelvis and, in the majority of instances, a concomitant chronic inflammation is present.

The authors conclude that a clinical diagnosis of cholesteatoma of the upper urinary tract can be made only when cholesteatomatous membranes are expelled in the urine. The presence of squamous cells in catheterized urine can indicate leukoplakia, cholesteatoma or squamous cell carcinoma. The pyelographic changes are not characteristic and the differential diagnosis between tumor and tuberculosis is not always simple.—*George W. Chamberlin, M.D.*

Skeletal System

O'Rahilly, Ronan. Epitriquetrum, hypotriquetrum, and lunatotriquetrum. *Acta radiol.*, May, 1953, *39*, 401–411.

A medial intercarpal space is found commonly between the lunate, triquetral, capitate, and hamate bones, and a lateral intercarpal space occurs occasionally between the scaphoid, capitate, and trapezoid bones. The spaces are occupied by intra-articular synovial folds.

The intercarpal spaces are the sites of occasional accessory carpal elements. The os epitriquetrum, situated dorsally in the medial space has been found by nine writers, and 2 further cases are illustrated. One instance of a similar palmar element, called "os hypotriquetrum," has been reported.

Fusions have been recorded between most of the carpal bones. The most frequent is between the lunate and triquetrum, creating the os lunatotriquetrum, and is usually characterized by a distal sulcus at the site of the os epitriquetrum.

Some instances of both the accessory bones and the fusions have been found in early human embryos. —*Lois Cowan Collins, M.D.*

Davis, James G. The osseous radiographic findings of chronic renal insufficiency. *Radiology*, March, 1953, *60*, 406–411.

As a general rule, the osseous changes in chronic renal insufficiency are manifested by diffuse osteoporosis and at times metastatic soft tissue calcifications. This paper presents a discussion of the bone changes in renal disease and the author reports a case in which the osseous reaction was primarily osteosclerotic. Evidence of marked renal disease plus an unusual bone density throughout the skeletal system was present in this patient and postmortem examination showed no cause for the sclerosis except the kidney disease.

The roentgenographic appearance of the bones simulated Paget's disease and metastatic carcinoma only slightly.—*Clyde A. Stevenson, M.D.*

Brailsford, James F. Some radiographic manifestations of early scurvy. *Arch. Dis. Childhood*, April, 1953, *28*, 81–86.

Early scurvy can manifest itself clinically before roentgen examination detects any change from the normal in bones. The hematoma is usually the initial lesion which attracts clinical attention. The first roentgenographic evidence may be a subperiosteal hemorrhage or fracture at the growing extremity of one or more of the long bones. Calcium may be deposited in the periphery of the hematoma enveloping one or more of the long bones which appear to have normal structure and density. These may be the only features present to suggest a diagnosis of scurvy.

Scurvy is the only condition, apart from hemophilia, leukemia and other diseases with their characteristic signs and symptoms, in which are seen multiple sites with subperiosteal hematoma around bones which may be apparently normal roentgenographically. These hematomas become readily organized with the administration of vitamin C. They calcify and become ossified; the new bone is gradually absorbed; and finally the affected bone becomes and remains indistinguishable from the normal bone in shape, size and structure.

The recent hematoma can be suspected from the presence of a fusiform soft tissue swelling; the roentgenogram will reveal nothing more at this stage, but within seven to fourteen days roentgen signs of the deposition of amorphous calcium can be detected towards the periphery of the hematoma. This is followed by a denser granular deposition and later its organization into bone when it shrinks and loses its regular peripheral outline. The lesion may be mistaken clinically, histologically and roentgenographically for sarcoma, but with vitamin C medication the ossified hematoma is gradually absorbed and the bone is left with normal features as distinct from the scurvy of the later age period. The roentgen features of unusual hematoma, seen in certain cases of osteogenesis imperfecta and paralyzed limbs, and the lesions of infantile cortical hyperostoses are considered in relation to the sequence of roentgenographic changes in the lesions in scurvy. The best proof of scurvy may be the response to the therapeutic test—complete resolution of the lesion when adequate vitamin C is administered.—*James F. Martin, M.D.*

Defilippis Novoa, E. C. A., Girardi, Valentin C., and Moreau, Marcelo H. Radiografías contrastadas en las lesiones del disco intervertebral. Nucleografía. (Contrast roentgenograms in lesions of the intervertebral

disc. Nucleography.) *Prensa méd. argent.*, April 24, 1953, *40*, 1011–1017.

Contrast roentgenography is used when the clinical diagnosis of herniation of the intervertebral disc is uncertain.

If myelography does not give sufficient information, injection of the suspected discs with a water-soluble contrast agent is employed.

In herniation of the nucleus pulposus the patient's pain is reproduced and the contrast medium is seen outlining the protruding disc.—*Charles M. Nice, M.D.*

Bremner, A. E., and Neligan, G. A. Benign form of acute osteitis of the spine in young children. *Brit. M. J.*, April 18, 1953, *1*, 856–860.

During the year ending April, 1951, the authors treated 7 young children who presented a strikingly uniform clinical picture of a benign inflammatory disease of the lumbar spine. They believe the lesion to be a staphylococcal osteitis.

The children were all under three years of age at the onset of the illness, which seemed to be insidious and undramatic. All cases showed irritability, loss of appetite, fever, limping, limitation of hip motion, stiff back with spasms of pain and eventual objection to sitting or walking or even to being handled. These symptoms usually increased in severity for five or six weeks and then became stationary or began to improve.

Roentgenograms of the lumbar spine were similar in all cases and showed narrowing of a disc space, with erosion of the adjacent margin of the body of either or both the vertebrae bounding it. In 1 case there was also a posterior displacement of the upper of the two affected vertebrae. In 2 cases, the anteroposterior view showed an angular scoliosis at the level of the lesion. In every case the Mantoux test was negative to a dilution of 1/100.

All the children were treated by rest in a plaster bed, 6 of them being sent home in their beds and observed as out-patients. One patient ran a temperature around 103° F. and so was kept in the hospital and given penicillin. They were all allowed up, without any restriction in their activity, as soon as recalcification was evident in the roentgenograms. This took from seven to twenty-two weeks from the onset of the illness. They have subsequently been followed for between four and sixteen months, and all remain well.

The authors feel that the diagnosis of osteitis of the spine may be difficult in any age group and especially so when the disease occurs in a benign form in a child who is not old enough to make known the site of his pain. However, little harm would probably be done in most cases by failure to detect a spinal lesion; the child is likely to make a satisfactory recovery without any treatment other than bed rest during the active stage of the infection. The chief penalty would be the unnecessary anxiety of relatives and doctors when these cases are wrongly diagnosed as tuberculosis. The true dignosis can usually be arrived at by (1) the negative tuberculin skin test, (2) the course of the roentgen changes, and (3) the limp with limitation of motion of the hip. The authors came to regard this latter symptom as reassuring evidence that the spinal lesion was pyogenic rather than tuberculous.—*Leslie L. Lemak, M.D.*

Lorber, John. Ectopic ossification in tuberculous meningitis. *Arch. Dis. Childhood*, April, 1953, *28*, 98–103.

The author describes a series of 5 cases of tuberculous meningitis in childhood which developed a spinal block, paraplegia and ectopic calcification around the pelvis and in the thighs.

Ectopic calcification has been described following post-traumatic paraplegia, cerebral hemorrhage and other diseases of the nervous system followed by widespread and progressive muscle paralysis. The etiology is little understood. The serum calcium, phosphorus and phosphatase levels are normal. Wilkins and his co-workers found that in a case of progressive myositis ossificans biopsy specimens of muscles and fibrous tissue which were about to undergo ossification contained 800 to 1,600 times as much phosphatase as did normal muscle. They felt that this gross excess of phosphatase may lead to a precipitation of calcium from normal serum, but could not explain why normal cancellous bone should be formed and not amorphous calcification. The ossification does not occur in the muscle but in the fascial planes, ligaments and tendons. Other factors mentioned as necessary for pathological ossification are decreased oxygenation and blood supply, local tissue damage and decreased local CO_2 tension or increased alkalinity of the tissues.

Clinically, it seems that the factor necessary for the development of ectopic calcification is a spinal cord lesion with paraplegia in flexion, leading to muscle spasm and prolonged immobilization with consequent osteoporosis.

The author observed ectopic ossification in 5 of 10 children who developed temporary paraplegia in flexion during streptomycin treatment for tuberculous meningitis and who survived more than three months. The ossification was found two to six months after the onset of the paraplegia; in all cases it affected the iliopsoas or the adductors of the thighs and their tendons below the level of the pelvis. The lesions were bilateral in 3 patients. They led to severe disability in 2 children by fixing the hip joints and to less severe symptoms in the others. Operative removal of the new bone in 1 child led to a more extensive deposition of new bone and a worsening of his condition. In 2 conservatively treated patients there was subsequent roentgenologi-

cal evidence of spontaneous absorption of new bone after recovery from meningitis.—*James F. Martin, M.D.*

Paul, Lester W. Hereditary multiple diaphyseal sclerosis (Ribbing). *Radiology*, March, 1953, *60*, 412–416.

An unusual type of bone dysplasia consisting of diaphyseal sclerosis was reported by Ribbing in 1949. The author adds 2 cases apparently identical to the 4 reported by Ribbing.

The essential findings are a fusiform thickening and increased roentgenographic density in the midportion of one or more long bones plus the fact that two or more members of the family have this condition. There is a tendency toward symmetrical involvement and the tibia and femur are most often affected. The general health of the patient is not impaired and symptoms referable to the bone lesions are absent or at the most consist of slight aching pain.

Garré's sclerosing osteomyelitis and Engelmann's disease must be considered in differential diagnosis. The multiple involvement and familial nature of this diaphyseal sclerosis rule out Garré's disease, while in Engelmann's disease the familial tendency is absent and the bone lesions are more widespread, with disturbances in gait, posture and growth.

The author recommends caution in the diagnosis of sclerosing osteitis unless skeletal surveys are done on both the patient and his family.—*Clyde A. Stevenson, M.D.*

Bonnin, J. Grant. Cysts of the semilunar eartilages of the knee-joint. *Brit. J. Surg.*, May, 1953, *40*, 558–565.

Cysts of the semilunar cartilages of the knee joint are similar to ganglions elsewhere but show a greater tendency to recur after inadequate removal. They are considered by the author to be active proliferative lesions rather than degenerative.

Trauma is a precipitating factor in about one-third of the cases; a history of minor or recurrent trauma is associated with a cyst in another third, and in the remaining third there is no history of injury and no operative evidence of injury to the cartilage. The relationship of a torn meniscus found at operation to the history of trauma is inconstant, suggesting that the cyst may contribute to the formation of a tear.

Cysts of the meniscii exhibit a triad of features: pain after exercise, relieved by rest, but often worse at night; the presence of a cystic swelling over the joint line; and acute localization of pain and tenderness on pressure on the joint line.

Air arthrography of the knee is said to be of limited value due to the increased soft tissue pressures around the affected meniscus which prevent the entrance of air and reduce the relative contrast on which a good quality air arthrogram depends.—*James J. McCort, M.D.*

Karshner, Rolla G., and Hanafee, William. Palm thorns as a cause of joint effusion in children. *Radiology*, April, 1953, *60*, 592–595.

Retained tips of date palm thorns may occasionally be the cause of joint effusion in children. These tips are brittle and break off easily in a puncture wound, often remaining unnoticed in or near a joint. They may introduce a pyogenic arthritis and apparently in sensitive individuals cause an immediate massive swelling. Usually, the reaction is a simple hydrarthrosis due to a foreign body giant-cell granuloma with hypertrophic synovitis and possibly a chemical irritation as well. The knee is almost always the involved joint, as shown by 7 typical cases, which are tabulated. Roentgenograms are not specific, but interrogation may give the diagnosis in a child with unexplained effusion in tropical latitudes.—*Wm. A. Goodrich, Jr., M.D.*

Drey, L. A roentgenographic study of transitory synovitis of the hip joint. *Radiology*, April, 1953, *60*, 588–591.

This entity has been defined as a condition which produces the symptoms and physical signs of arthritis of the hip joint associated with negative roentgen findings. The disease occurs in childhood and is of short duration. The cause is not known although low grade infection combined with allergy has been cited as a factor.

The author states that although there are no bony changes discernible, he was able to find pathognomonic roentgenologic changes in the soft tissues. A swelling of the synovial membrane is associated with a swelling of the muscles about the joint. This muscular swelling manifests itself in the roentgenogram as a broadening of the affected muscles and a disappearance of the intermuscular septum. The muscles about the hip which can be recognized and those in which this phenomenon is seen are the obturator internus, the iliopsoas, and the gluteus minimus. Edema of these muscles is pathognomonic of transitory synovitis of the hip.—*McClure Wilson, M.D.*

Beneventi, Francis A., and Spellman, Robert. Unsuccessful attempts to produce osteitis pubis in dogs. *J. Urol.*, March, 1953, *69*, 405–406.

In an attempt to further evaluate the etiology of osteitis pubis as it occurs in the human following operative procedures on the prostate and base of the bladder, the authors carried out the following experiments on three dogs:

In each dog, the bladder was opened at the time of surgery to permit the free seepage of urine around

the urinary bladder. In the first animal, the right obturator nerve was irritated by rubbing it with dry gauze for one minute. A loose strand of ∞ chromic catgut was then tied around it and left in place in order to produce further irritation of the nerve.

In the second dog, the periosteum of the posterior aspect of the pubic bone was fulgurated and the bladder urine permitted to bathe this area.

In the third dog, a large wedge of fibrocartilage was excised from the symphysis pubis and urine allowed to bathe the operative site.

Roentgenographic examination of the pelvis was made at three week intervals for a period of four to five months and throughout this period no evidence of osteitis pubis was demonstrated.—*George W. Chamberlin, M.D.*

Wirz, F. Die Osteoporose als Frühsymptom der Osteochondrosis deformans coxae juvenilis Perthes. (Osteoporosis as an early finding of osteochondrosis deformans coxae juvenilis Perthes.) *Schweiz. med. Wchnschr.*, April 18, 1953, *83*, 384–387.

The author reviewed the roentgen films of the early stage of Perthes' disease of the hips with particular attention to the presence of osteoporosis. In the literature, this finding is rarely mentioned as an early manifestation of Perthes' disease, but is considered to be a sign of tuberculosis of the hip joint. Of 73 cases in the various stages of the disease, 12 showed changes of the typical early stage; namely, widening of joint space, thickening of the epiphyses of the head of the femur, cystic areas of decreased density in the head and neck of the femur, and a widening of the femoral neck by bone deposition. In addition, two other little known findings were noted: a hypoplasia of both divisions of the ischial bone and of the inferior ramus of the pubic bone on the affected side, with corresponding asymmetry of the pelvis in 4 of 12 cases; and a swelling of the soft tissues of the joint due to chronic synovitis in 3 cases. In 9 of the 12 cases a definite osteoporosis was present as the initial manifestation of the disease. This finding was unilateral, often band-like, in the region of the epiphyseal line, and later somewhat diffuse in the neck of the femur and the upper portion of the shaft, but also extending occasionally into the neighboring part of the pelvis. The degree of the osteoporosis was much less as compared with that seen in tuberculosis of the bone. There was no relationship between the zones of radiolucency and the cystic areas which were formed later. The roentgen difference in density between the two sides was occasionally intensified by the presence of soft tissue atrophy on the affected side, but in no case did the latter by itself produce such an appearance.

In 5 of 9 cases, osteoporosis was present before the immobilization of the extremities, so that the finding cannot be attributed to inactivity. In addition, the osteoporosis was unilateral. In those cases where both lower extremities were immobilized, the osteoporosis was limited sharply to the involved side. The osteoporosis is apparently not only a manifestation of Perthes' disease, but an expression of extensive repair in this hip joint disease, which affects the epiphyses as well as the neck of the femur, the upper portion of the shaft, the acetabulum and the neighboring pelvic bones. In most cases, a chronic inflammatory process consisting of hypervascularity and lymphocytic infiltration was observed also in the joint-capsule and the affected muscle groups. In the latter stage of the disease, occasionally there may be an osteoporosis as a result of a new phase of structural repair. In 3 of 12 cases, there was a combination of Perthes' disease and aseptic necrosis of the ischiopubic synchondrosis.—*Samuel Richman, M.D.*

Steinberg, Charles LeRoy. Splenectomy in rheumatoid arthritis. *Ann. Int. Med.*, April, 1953, *38*, 787–813.

Felty described a syndrome of mild rheumatoid arthritis associated with fever, secondary anemia (in 4 of the 5 cases reported), leukopenia ranging from 1,000 to 4,200 leukocytes, splenomegaly and tachycardia. Rheumatologists are practically unanimous in believing that this syndrome is a variant of rheumatoid arthritis.

Experimental studies have shown that the hypophysis hypertrophies in patients following removal of the spleen.

Case records are given of patients with Felty's syndrome following removal of the spleen. In all the cases there was a marked improvement of the symptoms.

The authors conclude that splenectomy is the procedure of choice. They present evidence to suggest that the removal of the spleen results in hypertrophy of the anterior lobe of the pituitary. If this is true, then the procedure actually sets in motion a constant and increased supply of corticotropin in the individuals.—*J. H. Harris, M.D.*

Friedman, H. Harold, Schwartz, Sheldon, Trubek, Max, and Steinbrocker, Otto. The "pararheumatic" arthropathies. *Ann. Int. Med.*, April, 1953, *38*, 732–758.

The authors review the literature and present their observations on the rheumatic manifestations in the collagen diseases. Rheumatic fever and rheumatoid arthritis are briefly mentioned because they are usually easily diagnosed. However, lupus erythematosus disseminatus, polyarteritis nodosa, diffuse scleroderma and dermatomyositis present bizarre clinical features and are difficult problems in differential diagnosis. The incidence of musculoarticular manifestations in these latter "pararheumatic" diseases is high.

The types of muscular and articular involvement

are: myalgia, arthralgia, and polyarthritis. One of the "pararheumatic" diseases should be suspected if fibrositis is associated with fever, in acute or subacute polyarthritis of long duration with a downward course, in fulminating deforming polyarthritis, in "atypical" rheumatoid arthritis, and in arthritis with bizarre cutaneous lesions.—*F. B. Markunas, M.D.*

Blood and Lymph Systems

Kahr, E. Darstellung der Beckenvenen mittels transossärer Serienphlebographie. (Visualization of the pelvic veins by means of transosseous serial phlebography.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, April, 1953, *78*, 449–455.

The author uses transosseous serial phlebography to visualize the veins in the pelvis. The method described by Dela Pena, which consists of injecting contrast material in the vena dorsalis penis or clitoridis is not without danger and has been condemned in the literature. Although the injection of the contrast medium in the bone marrow is not new, having been reported by many since 1943, the author feels that his modification of this method yields more valuable results with more consideration to the patient. He uses general anesthesia with pentothal and makes serial phlebograms. Twenty cc. of a 35 per cent contrast material (umbradil or ioduron) is injected and serial exposures at five second intervals are made. About 4 to 5 exposures are considered sufficient. When injecting into the os pubis, the opaque medium passes into the retropubic veins, the vena obturatoria, vena hypogastrica and the vena iliaca communis, whereas when the injection is made into the greater trochanter, the vena femoralis, vena iliaca externa and the vena iliaca communis are visualized.

The results, after one year's experience with this method, are summed up as follows: (1) transosseous phlebography is the only suitable means of visualizing adequately the deep veins of the pelvis; (2) the danger accompanying the procedure is not to be belittled (the author reports a case in which a pulmonary infarct developed); and (3) although one is able to visualize the precise anatomic relationship of the veins in the pelvis or the accurate site of a phlebothrombosis, still the method has no practical value as a therapeutic measure.

The author concludes with the statement that in view of the risk involved and the negligible practical value, transosseous phlebography is not suitable as a routine method of examination and should be used only in selected surgical or industrial medical cases. —*S. Silvera, M.D.*

Steinbach, Howard L., Bierman, Howard R., Miller, Earl R., and Wass, Warren A. Percutaneous transhepatic portal venography; preliminary report. *Radiology*, March, 1953, *60*, 368–374.

The authors describe a method for performing percutaneous transhepatic portal venography. There is good visualization of the intrahepatic portal venous system because the contrast material is injected directly into it. The method does not require surgery and can be performed in the roentgenographic room. A 16 to 20 gauge needle, 20 cm. long, is inserted through the abdominal wall just below the xiphoid, directed at a 20 degree angle to the right. If the liver is of average size the needle is inserted in the transverse plane. If the liver is enlarged, the needle is directed at a 5 to 15 degree angle caudally. The needle is advanced through the liver until blood can be aspirated or until a depth of 15 cm. is reached. Both diodrast and neo-iopax have been used as a contrast substance.

Thirty-five venipunctures have been performed successfully and venograms have been obtained ten times. Four venograms were unsatisfactory. Periportal extravasation of the contrast material has occurred several times without obvious ill effects. Bile peritonitis did not occur in this series.—*Arno W. Sommer, M.D.*

Rigler, Leo G., Olfelt, Paul C., and Krumbach, Ronald W. Roentgen hepatography by injection of a contrast medium into the aorta; preliminary report. *Radiology*, March, 1953, *60*, 363–367.

Numerous efforts to opacify the liver for roentgen examination have been, for the most part, unsuccessful, or have required too elaborate a procedure.

The authors have obtained reasonably good roentgen opacification of the liver and spleen after rapid injection of 40 cc. of 70 per cent urokon sodium into the aorta at the level of the eleventh thoracic vertebra. Roentgenograms made at repeated intervals have given evidence of the presence of hepatic cirrhosis and of carcinomatous metastases.

While abdominal aortography is not without risk, the authors have had no more undesirable effects than have been reported in the several large series of cases in which smaller amounts have been used.—*Lynne J. Taylor, M.D.*

Milanes, B., Perez-Stable, E., Casanova, R., Bustamante, R., and Hernández, A. Chronic arterial occlusions of the lower extremities; an arteriographic study of 62 cases. *Radiology*, March, 1953, *60*, 394–400.

The authors present arteriographic findings in 63 cases of chronic occlusion of the principal arteries of the lower extremities.

Incidence of complications was found to be low. Localization of the occlusion and state of collateral circulation, as well as prognosis, were considered to

be excellent indications for the examination.—*A. Ralph Watson, M.D.*

von Ronnen, J. R. The roentgen diagnosis of calcified aneurysms of the splenic and renal arteries. *Acta radiol.*, May, 1953, *39*, 385–400.

Aneurysms of the splenic and renal arteries are recognized with increasing frequency by roentgen examination. The ring shaped calcifications, with central radiolucency, in the region of the arteries, are quite pathognomonic, and not likely to be mistaken for the other causes of calcification in the area. Laminagraphy is an important gain in the roentgen diagnosis. Aortography is the ideal method of establishing the diagnosis with certainty. The splenic artery aneurysms are about four times as frequent as the renal artery aneurysms. Study of postmortem records form various places revealed an incidence of 0.01 per cent for aneurysms of the renal artery and 0.04 per cent for aneurysms of the splenic artery.

The aneurysms of the splenic artery are probably the result of arteriosclerosis in most instances, but only about 11 per cent of the renal artery aneurysms were attributed to arteriosclerosis.

The majority of the aneurysms give no trouble, but occasionally the larger ones rupture, particularly during pregnancy. Surgical removal of the aneurysms involves splenectomy or nephrectomy in almost all cases. In view of the records of the recognized cases, a policy of watchful expectancy seems justified if: (a) the aneurysm is small (size of a cherry or smaller), (b) the aneurysm shows a completely calcified wall except for the loss of continuity that indicates the communication of the sac with the artery (there is no reported instance of a completely calcified aneurysm rupturing), (c) the aneurysm is asymptomatic, (d) the aneurysm is not combined with severe hypertension, and (e) the aneurysm is found in a female beyond the child-bearing period.—*Lois Cowan Collins, M.D.*

Silbert, Samuel, Lippmann, Heinz I., and Gordon, Elias. Mönckeberg's arteriosclerosis. *J.A.M.A.*, April 4, 1953, *151*, 1176–1179.

Mönckeberg's arteriosclerosis is a clinically benign form of blood vessel calcification. The calcium is deposited in the media. It must be distinguished from intimal arteriosclerosis, which goes on to progressive occlusion of the blood vessels. In Mönckeberg's arteriosclerosis thrombosis does not occur nor is the circulation impaired. The calcification, usually in the arteries of the lower extremities, is found by chance in young and middle aged persons with no symptoms.

The authors believe that this condition is rather rare. They have collected 53 cases.

The patients present normal oscillometric readings in spite of evidence of extensive calcification on the roentgenograms. The patients' ages ranged from twenty-seven to sixty-nine years. In 17, nocturnal calf cramps were present. The roentgen findings in the larger vesseels were characteristic.

In Mönckeberg's arteriosclerosis, calcification is deposited in the form of two white, finely sketched straight lines with a granular haze between. At approximately every centimeter there is a 0.5 mm. gap in these lines. In contrast, the intimal arteriosclerotic type of calcification appears as coarse flakes. In the smaller vessels of the foot differentiation between the two types is difficult.—*Lawrence A. Davis, M.D.*

Meacham, Gordon C. Plasma cell myeloma. *Ann. Int. Med.*, May, 1953, *38*, 1035–1047.

The author has studied 51 patients having plasma cell myeloma—22 females and 29 males. All patients had an anemia, macrocytic in 75.9 per cent. Several patients had pernicious anemia; therefore, it is suggested that all patients with pernicious anemia who do not respond to treatment should have marrow studies for plasma cells.

Roentgenological findings were present in all but 3 cases. Usually there were discrete punched out areas; however, in 7 patients there was only an osteoporosis. This was present in the skull also, a differential feature from senile osteoporosis.

Marrow findings furnished the ultimate diagnosis. The plasma cells were immature and usually represented at least 10 per cent of the total cells, although in 2 cases it was near 4 per cent.

There was a hyperglobulinemia in 61.2 per cent with a normal finding in 26.5 per cent. A high level should suggest the possibility of this disease. No relationship existed between the per cent of plasma cells and the globulin.

Bence-Jones proteinuria was demonstrated in 13 of 39 cases. This was usually associated with a nornal globulin level.

Hypercalcemia was present in a small per cent of the cases associated with a normal alkaline phosphatase.

No patient showed a tendency to hemorrhage.

Circulating plasma cells were present in more than normal levels in 16 cases.

Palliative benefit was obtained with the use of roentgen therapy, urethane and ACTH.—*V. L. Peterson, M.D.*

General

Prezyna, Anthony P., Ayres, William W., and Mulry, William C. Late effects of thorotrast in tissues. *Radiology*, April, 1953. *60*, 573–578.

The authors emphasize the dangers attending the intravenous use of thorotrast and report a case with extensive local changes following its use. Twelve years after this patient received an injection of thorotrast he presented himself with a painful mass, measuring 15×5×3 cm. in the antecubital region of

the right arm. There was limitation of motion of the elbow, weakness of the arm and numbness of several fingers. Roentgenograms revealed changes in the soft tissues about the elbow resembling myositis ossificans. Measurements of the antecubital region of the right arm by means of Geiger-Müller counter tubes revealed significant radioactivity. A quantitative estimate showed that approximately 20 to 25 per cent of the gamma-ray activity of a single vial of thorotrast still remained in the soft tissues. Radioautographs of the tissue exhibited alpha particle tracks arising from the area of the intracellular granules of thorotrast.

Thorotrast is responsible for serious damage which is often late in appearance. The continued, increasing radioactivity due to the breakdown of the thorium dioxide is responsible for this effect. The commonest complications are due to the accidental perivascular deposition, leading to destruction of the surrounding tissues. Rarely, its concentration within the reticuloendothelial system results in an aplastic anemia and the formation of malignant neoplasms.—*Arno W. Sommer, M.D.*

Wilkins, Lawson. Disturbances in growth. *Bull. New York Acad. Med.*, April, 1953, *29*, 280–294.

Growth may be altered by extrinsic factors such as nutrition or disease, genetic factors which cause constitutional differences in the endocrine pattern and diseases of the endocrine glands or the hypothalamus.

In studying dwarfism, simple growth must be differentiated from various types of development. Some of the various types of development which are easily evaluated are listed.

The author discusses the relation of the endocrine glands to growth and development. It is shown that an alteration of one of the hormones affecting growth or development may be caused by a disorder arising in either of the three centres of control: (1) hypothalamus, (2) anterior pituitary, (3) one of the target endocrines.

The author places the causes of dwarfism into seven classes. The first three comprise the metabolic, circulatory and specific bone diseases while the last four include the endocrine, primordial and progenic diseases and delayed adolescence. The peculiarities and differences are pointed out. It is stated that in the prepuberal years the differential diagnosis between delayed adolescence and growth, pituitary dwarfism, and primordial dwarfism is quite difficult. There is a brief discussion of the treatment of the various types of endocrine dwarfism.—*J. S. Whitmore, M.D.*

Li Moli, Salvatore. Malattia di Hand-Schüller-Christian con reperto istologico di granuloma eosinofilo. (Hand-Schüller-Christian disease with histological report of eosinophilic granuloma.) *Riv. clin. pediat.*, April, 1953, *51*, 641–657.

The author briefly reviews the various theories on the etiology of Hand-Schüller-Christian disease. In addition to other reports, he cites the work of Pinkus, etc., who in 1949 proposed a new classification of the diseases of the reticuloendothelial system, postulating three types under one general term of "reticulogranuloma" but distinguishing:

1. A systemic type with acute clinical course, usually fatal, nonlipoid reticulosis (Letterer-Siwe disease);
2. A granulomatous type with chronic progressive clinical course in which the xanthomatous transformation of granulomata predominates (Hand-Schüller-Christian disease);
3. A benign form, localized usually to the bones with tendency to spontaneous recovery (eosinophilic granuloma);
4. A mixed type.

The author's case is that of a 5½ year old girl with a classical clinical syndrome of Hand-Schüller-Christian disease and discrete, round osteolytic lesions of the skull; biopsy of the soft tissue cranial mass revealed eosinophilic granuloma. The hypophysis was given 1,000 r in air in one cycle; the vault and jaw lesions were given three series of roentgen treatments. The general condition of the patient improved over a period of six months; the soft tissue mass regressed and the osteolytic lesions gradually reduced in size. The diabetes insipidus, however, remained unaffected.

The author concludes that the etiology of the reticuloendothelioses is still unsolved and that the histology of the bone lesions does not always furnish differential criteria. They suggest that in the diagnosis, major importance be given to the clinical picture and classify their case as Hand-Schüller-Christian disease.—*Lucien Pascucci, M.D.*

Bonse, G., and Karg, R. Röntgenbefunde bei Angiomatosis Kaposi. (Roengen findings in Kaposi's sarcoma.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, April, 1953, *78*, 456–460.

Kaposi's sarcoma is more common in Slavic and Latin people and the age incidence is beyond the third decade. It affects the skin of the distal portion of the lower extremities symmetrically and progresses proximally along the course of the blood vessels. Eventually it becomes generalized, and practically all organs may be affected. When it involves the lungs, bladder or intestines, serious anemia develops due to blood loss. The patient dies after many years of advanced cachexia.

Roentgenographic examination with soft tissue technique reveals small masses which originate in

the subcutis and project like mushrooms above the skin surface. The absence of phleboliths is noteworthy. In the bones, according to the literature, there is usually periosteal deposition, atrophy, cystic changes or complete destruction of the affected part. In one of the authors' cases the roentgenographic examination showed changes of the enchondromatous type. The question of possible pathogenetic connection between angioma and enchondroma is discussed. Polyp-like filling defects were found roentgenographically in the jejunum and ileum in a case reported by Seagrave.

The authors base their observations on 4 cases of their own, all of which showed skin changes and a few skeletal changes but no visceral manifestations.—*S. Silvera, M.D.*

RADIATION THERAPY

Brown, W. M. Court. Symptomatic disturbance after single therapeutic dose of x-rays; its relationship to the general radiation syndrome. *Brit. M. J.*, April 11, 1953, *I*, 802–805.

The author has analyzed the symptoms of a group of 50 patients to whom a single therapeutic dose of roentgen rays was given to various sites, chiefly the whole trunk or the upper or lower halves. The mean dose was 3 to 4 megagram roentgens. It was found that there is a well defined latent period lasting on the average for 2½ to 2¾ hours, which terminates in the sudden onset of symptoms. The period of acute disturbance after lasting for a variable number of hours, passes into the recovery phase. The total duration of the symptomatic disturbances may last for one to five days.

The symptom pattern following a therapeutic dose of roentgen rays is a milder version of that seen with the general radiation syndrome observed in the survivors of the atomic bomb or after mid-lethal doses on experimental animals.—*Norman Heilbrun, M.D.*

Blomfield, G. W. Experience with two million volt x-ray therapy and a preliminary assessment of clinical results. *Proc. Roy. Soc. Med.*, April, 1953, *46*, 219–224.

The author reports on his clinical experience with the 2 mev. Van de Graaf apparatus which was installed at the Sheffield National Centre for Radiotherapy over three years ago (see former abstracts in this Journal). The clinical application was started in December, 1949, and until December, 1951, 749 patients were treated altogether.

In the present article the author, after briefly reviewing the physical advantages of this form of treatment as compared to the conventional 200 kv. therapy, analyzes the immediate results obtained in the series of 749 patients. The relative distribution according to type of lesion treated is shown in Table 1.

Table I

Diagnosis	No. Treated
1. Intracranial tumors	62*
2. Carcinoma mouth (tongue, alveolus, antrum, palate, etc.)	65
3. Carcinoma larynx	30
4. Carcinoma esophagus	16
5. Carcinoma bronchus and lung	39
6. Carcinoma rectum	20
7. Carcinoma bladder	65
8. Carcinoma cervicis uteri	227
9. Artificial menopause	79
10. Other cases	146
	749

* 12 of these nonmalignant.

The gain in each of these lesions is briefly discussed. A table comparing the central axis depth doses for various fields at 200 kv. and 2 mev. and several isodose charts for a single field and five field crossfiring (tumors of the pituitary fossa and bladder) are included.

Of particular interest is the author's technique in producing artificial menopause with 2 mev. therapy. He usually administers a single dose of 350 to 450 r to the mid-pelvis, by two contralateral fields of 15 by 15 cm. and a somewhat larger dose in younger patients. In obese patients, because of the relatively greater surface dose necessary to obtain an identical dose on the ovaries and to avoid undesirable intestinal reaction, it is more convenient to use the fractional method by giving a correspondingly increased dose.

In concluding, the author states that there is no doubt in his mind that the change to supervoltage roentgen therapy for the treatment of deep-seated cancer and certain other cancers and lesions is as well justified as the change from 150 kv. to 200 kv. roentgen irradiation which took place about twenty years ago.—*T. Leucutia, M.D.*

Wagner, Helmut. Milzbestrahlung und Blutmorphologie. (Irradiation of the spleen and morphology of the blood.) *Strahlentherapie*, 1953, *91*, 115–119.

After irradiating the spleen (110 r measured in air at 180 kv., 6 ma., 40 cm. f.s.d., with 0.5 mm. Cu filter, and an 8×10 cm. field) in 20 women, an increase in polymorphonuclear cells, erythrocytes, and erythrocytic resistance was observed within twelve hours. A decrease in eosinophils, lymphocytes and thrombocytes occurred within three hours.

The author considers these explanations for the observations: (1) Irradiation inhibited a splenic hor-

monal mechanism so that bone marrow activity was released. (2) Hematopoietic centers in the region of the spleen were affected by scattered radiation in the abdomen. (3) Radiation might have altered the tone in the vegetative nervous system. (4) Central influence might have occurred on hematopoiesis via the effect of insufficient or altered hormones on the vegetative nervous system. (5) Splenic irradiation, and perhaps the radiation effect on the left suprarenal gland, might have released a "stress" reaction.

Though the evidence adduced does not permit selection of the correct explanation, the suggestion that the spleen is capable of exerting an active influence rather than a purely passive role as a scavenger of aged cells, is strengthened.—*Henry G. Moehring, M.D.*

Batley, Frank. Complications and dangers of radium and x-rays in gynaecological conditions. *Canad. M.A.J.*, May, 1953, *68*, 460–463.

One should be careful to distinguish between the damage produced by the tumor (carcinoma of cervix) and that produced by the radiation. For instance, when the rectovaginal septum consists only of tumor, then removal of the tumor is sure to leave a fistula. Early reactions are diarrhea, tenesmus, and cystitis. Late reactions usually appear within a year. The commonest is pseudocarcinoma of the rectum, opposite the cervix, and it is a direct result of too high a dose on the rectal mucosa. A similar lesion may occur higher in the rectum from radium in a retroverted uterus resting against the bowel. Damage to the blood supply of the rectum and pelvis may result in hemorrhage, pain, indurated pelvis and rectovaginal fistulas, usually requiring a colostomy. Bladder damage leads to recurrent attacks of cystitis and hematuria and rarely ureterovaginal fistulas. Radiation-induced fracture of the neck of the femur has not been seen by the author who believes such accidents should be unknown with a proper technique. Occasionally necrotic areas of the skin develop in stout patients where it is difficult to get a proper depth dose without raising the skin dose.

The use of milligram hours as a unit of dosage is decried. A dose measured in roentgens is a measure of ionization and it is this ionization which produces tissue reactions, so the roentgen is the obvious measure.

One can practice radiation therapy without causing necrosis, but this can only be done by reducing the dose below an average curative level. If one attempts to cure as many cancer cases as possible, the risk of necrosis is a risk that the patient must take. The author quotes Ralston Patterson, "A necrosis is not always reason for blame, but a necrosis when the dose which caused it is unknown certainly is reason for blame."—*Robert K. Arbuckle, M.D.*

Young, Henry A., and Jonas, August F. Combined surgery and irradiation in the treatment of cancer of the cervical stump. *Surg., Gynec. & Obst.*, March, 1953, *96*, 288–294.

Incidence. In a large series of cases of carcinoma of the cervix, the authors found the incidence of cervical stump cancer to be 4.1 per cent. The incidence of cancer of the cervical stump following supracervical hysterectomy has been reported as varying from 0.45 to 1.0 per cent.

Lymphatic Spread. There are three principal lymphatic pathways along which carcinoma of the cervical stump may travel: (1) from the paracervical plexus and following the course of the uterine artery to the external iliac and obturator nodes, (2) from the paracervical plexus and following the uterine vein posteriorly, terminating in the hypogastric nodes and (3) through the uterosacral folds on both sides of the rectum, ending in the sacral nodes.

Prediction of Radiation Resistant Cases. To place the surgical approach to carcinoma of the cervical stump or cervix itself upon a scientific basis, Graham has recently undertaken to predict the cases which will show no radiation response. She studied 73 cases of cervical carcinoma by means of the vaginal smear during and immediately after radiation treatment. She has been able to trace every one of the 73 patients and the prognostic accuracy at the end of five years was 75 per cent.

Discussion. There are a considerable number of Stage I, II, and III radiosensitive cancers of the stump which, after the growth is locally controlled by radiation therapy, should be subjected to bilateral extraperitoneal lymph node dissection. In this way, by supplementing irradiation with pelvic lymph node excision, one may enhance the five year salvage rate of cases showing lymph node involvement. Moreover, the extraperitoneal pelvic lymph node dissection is within the capability of an average surgeon and can be performed upon poor risk patients without any untoward mortality.—*Mary Frances Vastine, M.D.*

Heyde, W., and Schmermund, H.-J. Zur Vermeidung von Darmschäden bei der intravaginalen Bestrahlung des Kollumkarzinoms. (On the prevention of injury to the intestinal tract in intravaginal irradiation of cancer of the cervix.) *Geburtsh. u. Frauenh.*, May, 1953, *13*, 392–401.

The theoretical advantages of intravaginal roentgen therapy in cancer of the cervix have not achieved general acceptance mainly because of the danger of radiation damage to neighboring organs. Post irradiation changes of the rectum and bladder are about the same as by other methods of irradiation, according to the recent literature. Damage to higher

intestinal segments is evidently more common when intravaginal roentgen therapy is used.

When routine roentgen examinations of the colon are done after radiation therapy relative stenoses and mucosal changes in the sigmoid are not infrequently demonstrated, even when there are no symptoms. At times definite obstruction was found. Postirradiation changes higher in the signoid and even in the descending colon occurring after intravaginal roentgen therapy may be explained by the presence of immovable and fixed loops in the pelvis. These loops are usually present in the left side of the pelvis. Diverticulosis of the sigmoid seems to be especially sensitive to radiation and appears to predispose to radiation damage.

At the University Clinic of Hamburg, Germany, a routine barium enema study with a vaginal treatment cone in situ is now a standard procedure. If unfavorable topographic relations of the sigmoid and descending colon are demonstrated, intravaginal roentgen therapy is considered contraindicated. It must be remembered that high placement of the radium in case of excessive elongation of the vagina will lead to the same consequences. Avoiding the very high placement of the radium by packs and fractionating the total radium dose over a longer period will definitely minimize radiation damage to the higher portions of the sigmoid or descending colon.—*Hans W. Hefke, M.D.*

RADIOISOTOPES

Closon, J. Or colloïdal radio-actif introduit par voie intra-veineuse portale; étude préliminaire, expérimentale et clinique. (Radioactive colloidal gold introduced by way of the intravenous portal route; a preliminary, experimental and clinical study.) *J. belge de radiol.*, 1952, *35*, 617–628.

The author utilized a solution of Au^{198} in colloidal suspension obtained from Harwell, England. The radioactive isotope was produced by submitting gold leaf to neutron bombardment. Subsequently, the gold leaf was dissolved in an acid solution and then was dried by heat in a vacuum to remove all trace of the acids. Following this, the gold salt was reduced in an alkaline solution in the presence of gelatin and ascorbic acid which resulted in a stable colloidal suspension. This hydrosol of gold has the color of red wine.

Untoward effects which might be expected when this preparation is injected intravenously are a foreign protein reaction from the gelatin, and "shock," as is observed when any metallic colloid is injected, particularly if administered too rapidly. The amount of gold introduced is insufficient to produce gold intoxication. Theoretically, stable mercury, which is the descendant of Au^{198}, might produce heavy metal intoxication but the quantity present is chemically, and therefore clinically, insignificant.

Experimental studies on rabbits were performed by slowly injecting about 3.5 mc. Au^{198} (0.5 cc./minute) into a mesenteric vein at the time of laparotomy. For the ensuing five days, fecal and urinary excrements were collected. On the sixth day, the animals were sacrificed by exsanguination. Samples of tissue, urine, feces and blood of the bleeding were studied to account for the fate of all of the injected gold. These specimens were ashed and pulverized according to the technique of Jentzer and Wagner. They were then uniformly spread in a fine layer in appropriate containers and compared with an aliquot quantity of the injected radioactive suspension, similarly prepared, by measuring with a Geiger-Müller counter. A high degree of consistency in these values was obtained with 3 rabbits which obviated further animal investigation. It was found that the liver retained 75 per cent; the bone marrow, 1.5 per cent; the muscle, 0.2 per cent; and the skin and lungs, 0.1 per cent. Interestingly, the renal cortex was found to be radioactive while the medulla was not, which presents an engaging problem in glomerular physiology. About 1.4 per cent of the injected isotope was eliminated in the urine and feces during the first five days. The liver concentration was highest with the bone marrow, splenic and pulmonary tissue following in that order. It is not surprising that the liver, with its parenchyma rich in reticulohistiocytes, retained the largest quantity of this colloidal material. Furthermore, these injections were made in the portal system and the suspension would first pass through the liver where a large portion (more than 75 per cent) was arrested, at least for the first six days.

On the basis of these observations, 2 patients with hepatic carcinomatosis were treated by injections of Au^{198} into the portal vein. One patient exhibited hepatic metastases from a primary lung tumor with marked painful hepatomegaly. In addition to general supportive measures, this patient received about 100 mc. Au^{198} injected into an epiploic vein. Subsequent studies revealed the greatest retention of the isotope to be in the liver. During the first fifteen days urinary, fecal and salivary output of Au^{198} amounted to 2.2, 0.4, and 0.05, per cent respectively of the total injected dose. On the eighth, ninth, and tenth days, B.A.L. was given which caused a definite rise in each of these values. The liver volume had diminished to one-half in ten days with complete alleviation of pain. A liver biopsy one month after treatment revealed little alteration in the neoplastic tissue, but significant fatty infiltration was seen. The patient died six weeks following the procedure due to cardiopulmonary complications. An autopsy was not performed. No radiation sickness, anaphylactic reaction, or signs of gold intoxication occurred during this period. A leukopenia was observed, however, during the first three weeks with a drop in the white blood cell count from 9,100 to 1,800. There was an increase

in the percentage of polymorphonuclears and a progressive anemia.

The other patient had considerable enlargement of the liver, which was hard, nodular and painful on palpation. There were signs of biliary obstruction and a liver biopsy revealed a metastatic glandular carcinoma, probably of bladder origin. This patient received 85 mc. Au^{198} via the portal vein at laparotomy. B.A.L. was not given. Hepatic retention, as demonstrated by surface measurements with a Geiger-Müller counter and by radioautography, was by far the largest. During the first fifteen days, renal, fecal, and salivary elimination was 0.9, 0.26, and 0.1 per cent respectively, of the total injected dose. These values were somewhat lower than in the first patient due, apparently, to the absence of B.A.L. The liver size was markedly diminished, the pain was relieved and the pruritus was lessened. The functional state of the liver was apparently unaltered one month later. Again, leukopenia with hypochromic anemia was observed, but no other deleterious effects appeared. The patient died two months following the procedure due to pulmonary infection and intestinal hemorrhage.

It can be seen that although the course of the disease was unaffected, marked reduction in liver size and alleviation of pain was accomplished.

Tables and graphs are presented which tabulate the experimental and clinical data in detail.—*Kenneth L. Krabbenhoft, M.D.*

Andrews, Gould A., Root, Sam W., Kerman, Herbert D., and Bigelow, Robert R. Intracavitary colloidal radiogold in the treatment of effusions caused by malignant neoplasms. *Ann. Surg.*, March, 1953, *137*, 375–381.

Roentgen therapy has been used for many years as a means of controlling the effusions associated with neoplastic involvement of the pleural and peritoneal surfaces. Good results are sometimes realized but radiation sickness and the uncertainty of benefit are undesirable aspects of this form of treatment. Müller is believed to have been the first to suggest the use of intracavitary colloidal radioactive gold for the management of ascites and pleural effusion.

Radioactive gold is particularly well suited for this purpose, having a beta particle of 0.98 mev. and two gamma rays of 0.12 and 0.41 mev. in its emission spectrum. Its biological effect is principally due to the beta particles which penetrate only a few millimeters in tissue. The $gold^{198}$ is in the form of a sterile colloidal solution of 10–25 mc./ml. In this form it is relatively inert biologically and the particles remain in or near the cavitary lining.

The authors have thus far used this preparation only in incurable cases suffering distressing symptoms as the result of fluid accumulation. Those considered most suitable are in good general condition and have symptoms predominantly related to the effusion. The presence of large masses is an unfavorable sign but need not preclude the use of $gold^{198}$. The authors treated patients in near terminal states and with severe symptoms due to complications other than fluid for possible palliative effect. Patients exhibiting multiple tumor implantations on the pleura or peritoneum, but without effusion, and patients with lesions known to have a propensity for peritoneal spread have not been treated. It is postulated that $gold^{198}$ might be used prophylactically in these cases, being cognizant of possible deleterious effects of such treatment.

The energetic gamma emission of $gold^{198}$ creates a rather serious personnel protection problem. A 25 cm. segment of polyethylene tubing, locked in place with a purse-string suture, is used as a means of administering the isotope to provide safe distance for the operator. Furthermore, such a tube is less likely to penetrate a viscus than a needle, and a sufficient length can be inserted into the cavity to insure against partial withdrawal with consequent injection into the tissues of the body wall. Most of the effusion is removed to prevent excessive dilution, but a quantity sufficient to provide easy location of the cavity is left. An apparatus resembling an intravenous infusion set is then attached to the tubing for administration of the isotope and the system is thoroughly rinsed at least three times; 200–300 cc. of saline is used for rinsing, the procedure requiring about 30 minutes, after which the tubing is removed immediately or within 24–48 hours and the wound sutured tightly. The patient then changes position at intervals to insure even distribution of the solution.

Reactions consisting of nausea, vomiting, weakness, and malaise are usually mild in degree and last two to three days. They are more prominent with intraperitoneal administration than when given intrapleurally. Occasionally diarrhea is experienced where the injection is intraperitoneal and pleuritis may occur after intrapleural injection. More profound sytemic effects are seen in patients with relatively normal serosal surfaces than in those with thick, fibrous surfaces. Bone marrow depression of a slight degree is not unusual, although 1 patient who received a total of 501.4 mc. in divided doses had a pronounced depression from which he promptly recovered.

The authors used multiple, small doses early in their experience, but recently have employed single, rather large doses. Further experience tends to indicate that a lag from the time of treatment to the cessation of fluid formation may occur so that smaller doses than apparent may prove adequate. They feel that larger doses are required intraperitoneally than are needed intrapleurally. It is suggested that doses of 75 mc. and 150 mc. not be exceeded for the intrapleural and intraperitoneal routes respectively.

Improvement is manifested by a lesser rate of

fluid reaccumulation, diminution or disappearance of blood and/or malignant cells from the effusion, and improvement of the general condition. The authors report their results in 24 cases, 8 of which had good clinical results. Four of these 8 patients were uncontrolled previously by roentgen therapy. Poor results were seen in advanced cases with cachexia, massive neoplasms and intestinal obstruction. Two patients with lymphosarcoma and 2 with pseudomucin-producing carcinomas of the ovary received little benefit. An autopsy performed on a patient who had received a total of 65 mc. of gold^{198} over a period of ten months revealed a profound fibrotic reaction with marked adherence of small bowel loops to each other.

It is concluded that the intracavitary injection of colloidal radiogold is of distinct palliative value in properly selected cases and may obviate, in large part, the radiation sickness attendant on the administration of roentgen therapy in such patients. Its prophylactic use in certain lesions is postulated.

A detailed chart with information pertinent to all of the patients treated is presented.—*Kenneth L. Krabbenhoft, M.D.*

Andrews, Gould A., Root, Samuel W., and Kniseley, Ralph M. Metabolism and distribution of colloidal Au^{198} injected into serous cavities for treatment of effusion associated with malignant neoplasms. *Cancer*, March, 1953, *6*, 294–302.

Distribution and excretion data on Au^{198} were obtained during the course of treating patients with pleural and peritoneal effusions. Information was thus obtained on the fate of the isotope when injected intracavitarily.

A preparation of Au^{198} containing a total amount of 3 to 9 mg./cc. of gold and possessing a radioactivity of 10 to 25 mc./cc. was utilized. Single doses varied from 10 to 235 mc. and were injected through a polyethylene tube inserted into the cavity to be treated.

Thirty patients were treated. Radioassay of tissues obtained both at laparotomy and/or autopsy was performed on 13 patients. All radioassays were carried out by employing liquid techniques and the measurements were made under a calibrated end-window Geiger tube. These methods of investigation included determination of the radioactivity in the effusions at intervals after the injection of Au^{198}, in 24 hr. urine samples, in frequent blood specimens, in stool specimens, in biopsy and in autopsy specimens. Tissues were also studied by histological and autoradiographic techniques.

In the injected cavity, complete mixing of the radiogold with the fluid usually occurred in the first few hours. Graphic representation of the fall in levels of radioactivity in patients receiving Au^{198} both intrapleurally and intraperitoneally is presented. This decline is explained principally by removal of gold from the fluid but dilution by further fluid formation is also a factor. Blood and urine concentrations of Au^{198} were found to be minimal immediately following administration of the isotope, indicating little absorption or excretion. Hepatic localization was not prominent. These results were corroborated by tissue assays and autoradiograms which demonstrated major deposition of the radiogold in the superficial layers of the serosal surfaces. Phagocytosis in both the surface layers and in the fluid itself was seen.

Determinations of radioactivity in the blood were divided into red-cell and plasma fractions. Red-cell activity was low compared to that in the plasma. This may have been due to residual plasma, however, since the samples were not washed. Increase in plasma radioactivity was more gradual and uniform with intrapleural administration than with intraperitoneal injection. The manner in which the blood activity appeared is thought to be the result of delayed mobilization of the material from the cavitary walls, probably in the colloidal rather than the ionized state.

Urinary excretion constituted a small but highly variable percentage of the total injected dose. The largest percentage was excreted during the first 24 hours when the blood level was low. Later, urinary excretion of Au^{198} was proportionate to the blood level. It is postulated that the initial period represents uptake and excretion of the ionized gold which is readily absorbed, whereas later it is the less readily absorbed and excreted colloidal gold which is found in the urine.

Tissue assays demonstrated uneven deposition of radiogold in the cavitary lining despite uniform mixing in the fluid. There was no selective concentration in tumor nodules. Assays on surgical specimens indicated that the somewhat spotty deposition on the surfaces resulted from inconstancy in sample surface area relative to weight. No significant penetration beneath the superficial layers was seen. Similar findings were obtained utilizing autopsy specimens. A table gives percentage values of hepatic and splenic concentrations and demonstrates significant variations in different patients. The lymph nodes in the vicinity of the injected cavity contained relatively high concentrations, whereas those more distant contained lesser amounts.

Local radiation effect was due almost entirely to the beta emission and this was principally absorbed in the first mm. of the surface. Chamberlain's method of dosage calculation expressed in equivalent roentgens is cited. The γ emission of Au^{198} contributes a significant total-body radiation effect. Hematological studies revealed a distinct mild radiation damage to the bone marrow, particularly in patients receiving large doses. Autoradiograms of bones containing active marrow further substantiated this observation. The liver removed a large portion of the radio-

gold reaching the blood stream. Thymol-turbidity and cephalin-cholesterol flocculation tests were not visibly altered by this type of therapy.

Mechanisms suggested by the authors in explaining the action of Au^{198} in controlling effusions are: 1) fibrosis of tumor surfaces, 2) diminution of lymphatic obstruction by irradiation in the lymph node substance, 3) partial inflammatory obliteration of the serous cavity, and 4) unknown action on uninvolved portions of the cavity surface. The deterrent action of Au^{198} on fluid formation in serous cavities is incompletely understood.

Numerous tables record the data upon which the authors base their discussion.—*Kenneth L. Krabbenhoft, M.D.*

Kniseley, Ralph M., and Andrews, Gould A. Pathological changes following intracavitary therapy with colloidal Au^{198}. *Cancer*, March, 1953, *6*, 303–312.

Au^{198} is a suitable agent for the treatment of effusions resulting from pleural and peritoneal carcinomatous involvement because of its half-life of 2.7 days and its radiation characteristics. It emits β particles with an energy of 0.97 mev. and with a maximum range in tissues or water of 3.8 mm. A low energy γ ray of 0.41 mev. is also emitted.

The authors have treated about 30 patients with Au^{198}, 12 of whom were autopsied and are reported in detail. All were in an advanced stage of their disease, were considered incurable by surgical or radiotherapeutic means, and were incapacitated by pleural and/or peritoneal effusions. Extensive clinical examinations were performed subsequent to administration of Au^{198} to determine excretion of Au^{198}, radiations from the body surface, hematological status, blood-chemistry values, function tests, rate of effusion formation and concentration of the isotope in the fluid. The largest single dose of Au^{198} injected was 187 mc. and the largest cumulative dose given to any patient was 659 mc. over a ten month period. Cases in which death appeared imminent were given small additional doses of Au^{198} to provide studies on the concentration and distribution in various tissues.

It was found that the walls of some of the treated cavities grossly presented a bluish-purple color due to staining by the colloidal gold. If the interval between treatment and autopsy was long, a reticulated pattern of black or gray color suggested lymphatic uptake and deposition. Occasional hemorrhagic and necrotic zones were seen. Fibrous thickening varied widely in degree and no correlation between the fibrosis and length of treatment or dose could be made. Evaluation of the amount of fibrosis was obscured in part by the association of a marked desmoplastic reaction with some tumors. Repeated paracenteses produced scarring which further complicated this problem. Microscopically, a zone of fibrous thickening was seen, usually with a surface layer of fibrin. Radiation change in the tumor was not prominent, being limited to superficial areas.

The particle size of Au^{198} is from 20 to 200 mμ. Most of this was absorbed by the cavity surfaces, some of it being phagocytosed, and only a fraction remained in colloidal suspension in the fluid. The colloidal particles coalesced to form granules of about 2μ diameter and were seen in clumps near the surface. Customarily they were in phagocytes, but occasionally were extracellular in location, enmeshed in fibrin.

The regional lymph nodes did not show consistent deposition of Au^{198} particles. When present they were seen either in the parenchyma of the node or in the sinusoids.

The authors also state that generally no demonstrable gross adverse effects were produced in the neighboring organs. Radiation ulcers in the intestines were found in only one case and bone marrow change as an indicator of total body irradiation damage was not prominent. Moderate degrees of bone marrow depression were observed but these effects were transitory, following by prompt recovery. No characteristic splenic or hepatic changes were seen.

Photomicrographs amply illustrate the histological changes described.—*Kenneth L. Krabbenhoft, M.D.*

Langer, Alexander, and Loevinger, Robert. A computational procedure for the isotope method of brain tumor localization. *Science*, March 6, 1953, *117*, 247–248.

The authors developed a computational procedure of activity mapping of the skull surface following administration of radioisotopes for the purpose of localizing brain tumors.

This consists in taking two readings, equally removed in time from the beginning and end of the total examination time, for each of the 32 known standard points of the skull. The sequence of the readings devised to ensure the equal spacing is described. Then the two counts for each point are summed and converted into percentage values by taking the arithmetic average of the figures of the 32 points and expressing the value at each point in percentage of this average.

As a preliminary step, the authors performed a series of measurements in 13 persons without an organic brain lesion and determined the average surface activity pattern for the normal head. The map showing in a single visualized plane the distribution of the 32 points with their standard designations used in isotope localization techniques and the percentage activity at each of these points in the normal skull is reproduced.

In studying patients with brain tumors, they have compared the individual results obtained with the figures of the normal pattern by paying attention to the following values: (1) pair of counting rates at two symmetrical points on the skull; (2) asymmetry

in counting rates, expressed as percentage of the low counts; (3) average counting rate over the skull; (4) percentage activity at each point; (5) excess percentage activity as compared to normal skull; and (6) asymmetry in excess percentage activity (corrected asymmetry). Each 15 per cent increase of activity was arbitrarily taken as a unit and an increase over one unit was assumed to be indicative of brain tumor. By coordinating the increased activity zone with the angle of collimation, it was possible to delineate the shape, size and area of the tumor.

The counting was carried out with two bismuth-wall Geiger-Müller tubes which were mounted in 14 mm. thick lead collimators and fixed in the cylindrical holes so that the resulting angle of collimation was about 30 degrees. The radioactive material was administered intravenously and consisted either of di-iodo^{131}-fluorescein or iodinated human serum albumin, furnished by the Abbott Laboratories, North Chicago, Illinois. The patient was placed for the counting, whenever possible, in a barber's chair provided with head and chin rests.

In concluding, the authors express the opinion that, although their experience is based on only 80 cases, the procedure will probably prove useful also for the localization of nontumoral lesions of the brain which are characterized by a decreased rather than an increased uptake of the radioactive substances.—*T. Leucutia, M.D.*

Fedoruk, S. O., Johns, H. E., and Watson, T. A. Isodose distributions for a 1,100-curie cobalt^{60} unit. *Radiology*, March, 1953, *60*, 348–354.

Isodose curves and depth dose data of the cobalt-60 therapy unit at the Saskatoon Cancer Clinic are presented. The unit produces a beam equivalent to about 3 mev. and delivers 33 r per minute, at 80 cm. distance. A revolving cylinder type mechanism and tapered lead collimators are utilized. Due to a source of 1 inch by 1.25 cm., a moderate penumbra results about each field. It is wider with 15 cm. square fields than with smaller ones, and could not be further reduced because the collimator must be at least 15 cm. from the skin to avoid secondary electron scatter. The penumbra is no handicap, however, and the isodose distributions compare favorably with those of 2 to 3 mev. roentgen rays.—*William A. Goodrich, Jr., M.D.*

Künkel, H. A., and Schmermund, H. J. Clearance-untersuchungen mit Na^{24} in der Haut und im subcutanen Gewebe. (Clearance studies with Na^{24} in the skin and in the subcutaneous tissues.) *Klin. Wchnschr.*, April 15, 1953, *31*, 380–384.

Aldrich and McClure, in 1923, described a test for the study of diseases which are due to changes in the hydration of tissues. They injected physiological saline solution intracutaneously and produced a well demarcated elevation (wheal) in the skin. The time of resorption of this saline solution, checked by palpation, was correlated with the hydration and capillary blood flow of the tissues.

The present authors have replaced the palpation method by radioactive saline solution and Geiger counters. With both a beta-ray counter and a gamma-ray counter simultaneous measurements of the clearance rates were carried out for cutaneous and subcutaneous tissues and it was found that the two may vary widely from one another. The often observed fact that the beta-ray decay curve of intracutaneous radioactive wheals does not follow an exponential law was confirmed by a special experimental set-up. —*Otto Glasser, Ph.D.*

Rust, John H., Wilding, James L., Trum, Bernard F., Simons, C. S., Kimball, A. W., Jr., and Comar, Cyril L. The lethal dose of whole-body tantalum^{182} gamma irradiation for the burro (equus asinus asinus). *Radiology*, April, 1953, *60*, 579–582.

This paper deals with an effort to establish the LD 50/30 for animals of the approximate mass of man. The LD 50/30 is that amount of radiation required to kill 50 per cent of the exposed animals in 30 days. Burros were used in this study.

The source of radiation was tantalum 182 arranged in a hexagonal pattern around a paddock 50 feet in diameter.

The dose in gamma roentgens was determined and found to be in the neighborhood of 651 r. The dose rate was in the range of 17.9 to 22.7 r/hr. The mean survival time of all animals dying of acute whole body irradiation was 26.5 days.—*McClure Wilson, M.D.*